K C0154
ITEM 4

INSTRUCTION BOOK

FREQUENCY METER LA-6

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MORGANVILLE, NEW JERSEY

FREQUENCY METER LA-6

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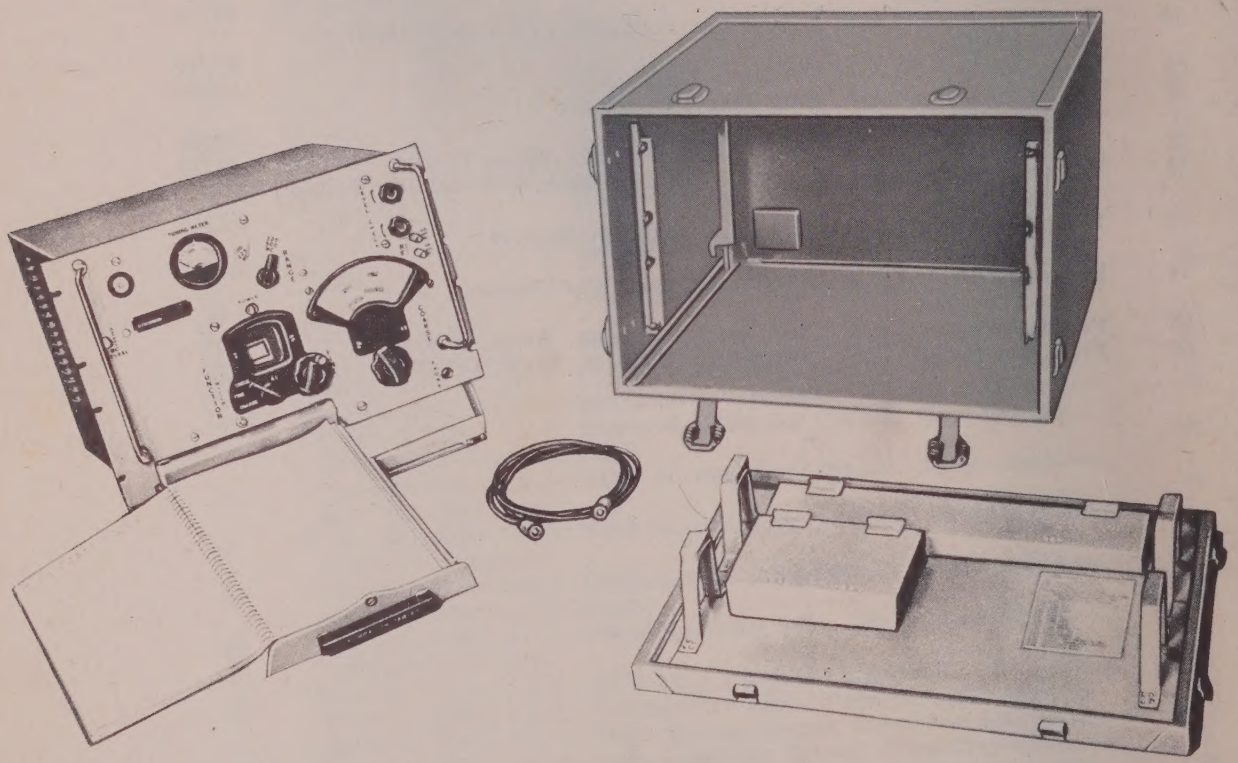


Figure 1. Frequency Meter LA-6 With Transit Case

NOTE: Optional transit case supplied at a small additional charge

CHAPTER 1

INTRODUCTION

Section I. DESCRIPTION AND DATA

1. SCOPE

This manual contains instructions for the installation, operation, maintenance and repair of Frequency Meter LA-6 (fig. 1).

2. Purpose and Use

a. Frequency Meter LA-6 (fig. 1) is a precision instrument used to measure the frequency of an amplitude-modulated (am) or frequency-modulated (fm) carrier within the range of 100 to 500 megacycles (mc), with an accuracy of one part in 100,000. It is a portable self-contained unit. For permanent installations, the major component LA-6 may be mounted in a standard 19-inch rack.

b. Measurement of an unknown frequency is accomplished by heterodyning a signal of known frequency, produced within the frequency meter, against the frequency under measurement to detect a zero beat. Headphones and a meter provide visual and aural indications of zero-beat settings. A system of check points is provided to check the calibration of the instrument at intervals throughout its operating range. The frequency meter can be used as a signal generator over the range of 100 to 500 mc. It is a valuable instrument for use in calibrating radio receivers.

3. Technical Characteristics

Frequency range:	
Range 1	100 to 225 mc.
Range 2	225 to 500 mc.
Power supply	Nominal line voltage 115 v ac or 230 v ac, 50 to 1,000 cps.
Line voltage stability	±10%.
Operating temperature range	-4° F to +125° F.
Rf output voltage	At least 50 uv into a 50-ohm load.
Spurious response	40 db down from desired signal level for any spurious response generated by the equipment.
Sensitivity	At lease 10,000 uv over entire frequency range with audio signal output at lease 1 db above noise level.
Audio-output power	1 mw minimum for signal plus noise into a non-reactive load of 600 ohms below 500 cps with an input of 10,000 uv.
Oscillator frequencies:	
Crystal	4 mc.
Interpolation	166 to 340 kc.
Audio	800 ± 300 cps.
Rf input impedance	50 ohms
Accuracy	001%.
Modulation frequency	800 ± 300 cps.
Power requirements	150 watts.
Number of tubes	25.

4. Packaging Data

When packaged for export shipment, the components of Frequency Meter LA-6 are placed in moisture-vapor-proof containers with a desiccant. These packages then are packed in wooden export crates. A typical unit packed for export shipment is shown in figure 6. The dimensions of the unit are shown in figure 7. When packaged for shipment, Frequency Meter LA-6 is 25 inches high, 19 inches wide, and 24.5 inches deep. It displaces approximately 6.7 cubic feet and weighs 140 pounds.

5. Table of Components

The following chart lists the components that make up Frequency Meter LA-6, the number required and the over-all dimensions of each component.

Component	Required No.	Length (in.)	Width (in.)	Depth (in.)	Volume (cut. ft.)	Weight (lb.)
Frequency Meter LA-6	1	17.2	18.9	12.3	2.32	60
Meter Case	1*	20.75	22.5	15.97	4.32	28
Manual	2					
Calibration tables	1					
Cord (CG-409/U)	1					

* When supplied.

6. Description of Components

a. Frequency Meter LA-6 can be used as a portable instrument or can be mounted in a 19-inch rack. The frequency meter consists of a panel framework assembly containing seven subchassis. The main frame is divided into three sections. The top section or deck contains the interpolation oscillator, check system, band-pass amplifier, and crystal oscillator and balanced-modulator subchassis. The lower section, mounted vertically on the main frame, contains the power supply on the left and the preamplifier and front end subchassis on the right. The front panel contains all operating controls and instruments, and input and output connections (fig. 11). The rear of the main frame (fig. 33) mounts two power fuses, two spare fuses and a potentiometer. The chassis and panel are secured to the

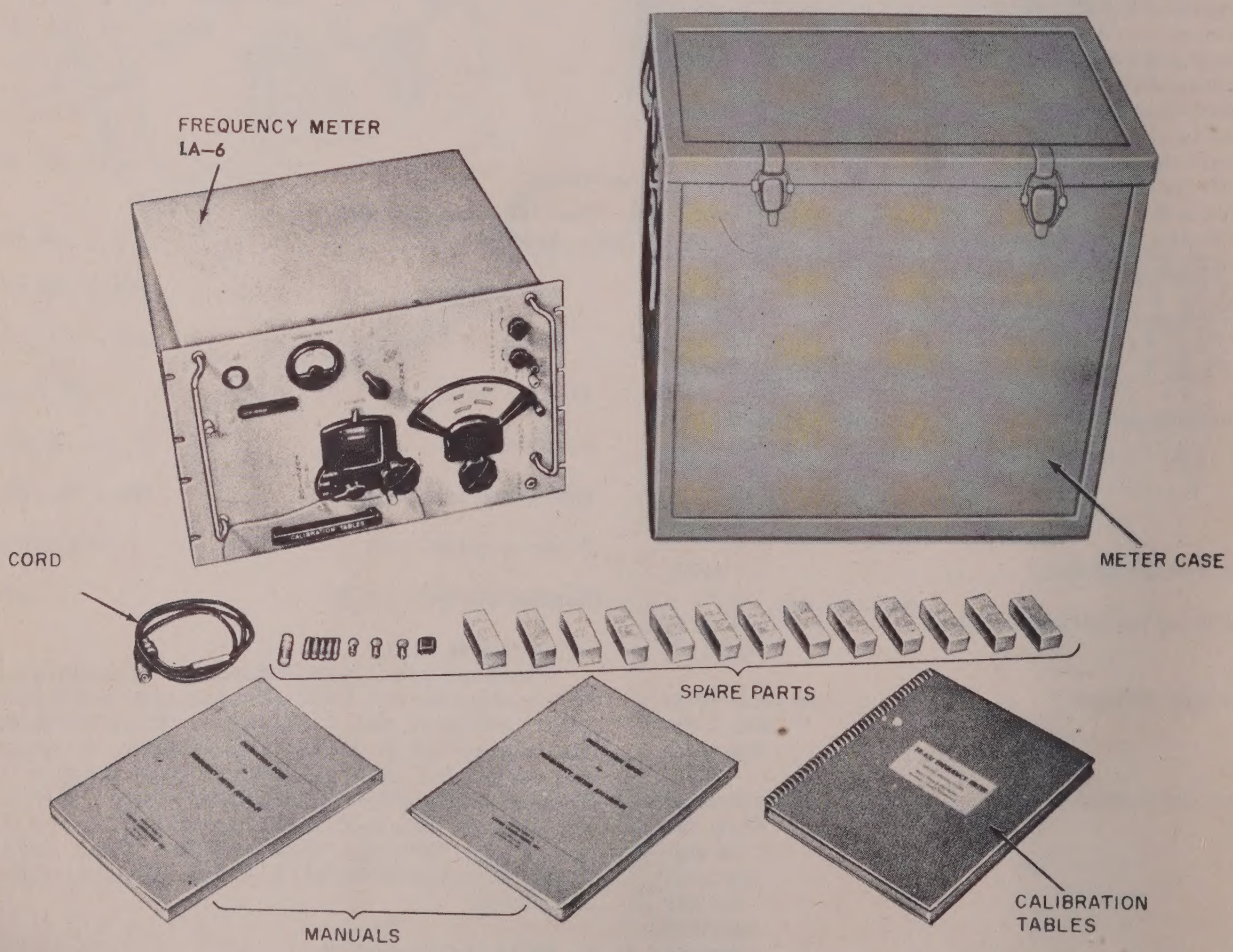


Figure 2. Frequency Meter LA-6, Components

louvered dust cover by eight screws. Releasing tension on the screws is sufficient to allow withdrawal of the unit dust cover. A pair of carrying handles (fig. 3) are mounted on the front panel for removing frequency meter from its transit case and dust cover. The calibration book drawer is located underneath the front panel and tilts downward when fully extended. The power cord is in a shelf at the lower left rear, below the dust cover, during transit or storage. A hinged door permits access to the power cord and fuses.

(1) Band-pass amplifier subassembly. This subassembly is located in the center of the top deck (fig. 5). The component reference symbols are in the 800 series and are mounted on the chassis in split levels.

(2) Interpolation oscillator subassembly. This subassembly is mounted at the right side, front of the top deck (fig. 5). Its component reference symbols are in the 400 series.

(3) Power supply subassembly. The power supply subassembly (fig. 35) mounts an audio-frequency oscillator, an audio-frequency amplifier, and meter outputs circuits in addition to the power supply. The component reference symbols are in the 100 series. This subassembly is mounted on the left side of the equipment, between upper and lower decks.

(4) Rf tuner subassembly. The radio-frequency (rf) tuner subassembly (fig. 34) is mounted on the right side of the main chassis between the top and lower decks. The component reference symbols are in the 500 series. The subassembly consists of two parallel transmission lines, their tuning capacitors, and the associated gear and dial system.

(5) Crystal oscillator balanced-modulator subassembly. This chassis is located at the left side on the top deck (fig. 5). Its component reference symbols are in the 600 series. The top side mounts a crystal unit, inclosed in an oven thermostatically controlled at 75° C (167° F).

(6) Check system subassembly. The check system subassembly is located on the top deck at the right rear (fig. 5). Its component reference symbols are in the 300 series.

(7) Preamplifier subassembly. This subassembly is located between the top and lower decks on the right side (fig. 34). Its component reference symbols are in the 200 series.

(8) Main frame. The main frame is composed of the upper and lower decks and the front panel. Its component reference symbols are in the 700 series. All subassemblies are mounted on this frame. The film mechanism (fig. 33) is mounted in the center of the lower deck.

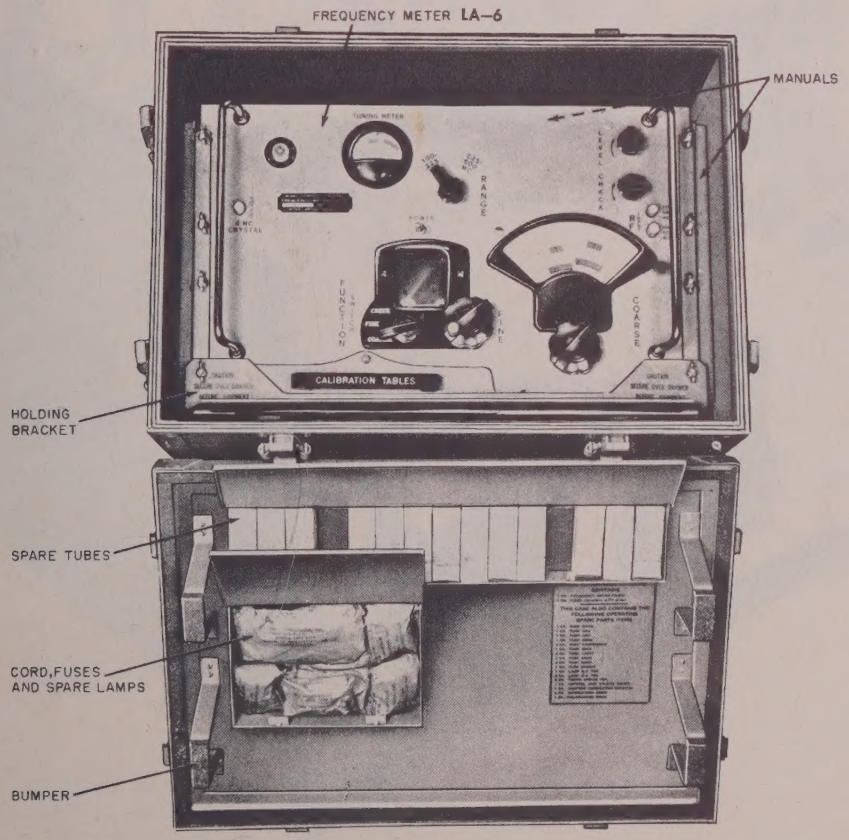


Figure 3. Frequency Meter LA-6, Components Packed in Meter Case

b. Meter Case (optional). The components of the Frequency Meter LA-6 may be housed in Meter Case (fig. 3). This case may be used for storage and transportation. The case is a metal-clad wooden case with a hinged-latch top. The top is fastened down by latches on the four sides. When placed inside the case, the frequency meter is secured by bumpers to prevent damage from shock and vibration. Carrying handles on the sides facilitate handling the case. Inside the case cover, a separate compartment contains the running spares, manuals, and rf cables.

c. Cord (CG-409/U). Cord consists of a 5-foot length of Radio Frequency Cable RG-58C/U with a Radio Frequency Plug UG-88/U at each end. This cable is used to connect the frequency meter to the unit under test.

d. Accessories. The following accessories are supplied with Frequency Meter LA-6.

(1) Calibration table.
(2) Allen wrenches.

7. Running Spares (optional)

Following is a list of running spares for the frequency meter. These items are stored in the cover of the transit case.

1 electron tube 6X4W
1 electron tube OA2
1 electron tube OB2
1 electron tube 6BN6
1 electron tube 5749/6BA6W
1 electron tube 5814
2 electron tubes 12AT7
2 electron tubes 6AU6
2 electron tubes 6AH6
1 electron tube 6AQ5W
1 Crystal CR-28/U (4-mc)
5 Slo-blo fuses (1.5 amp)
1 lamp type No. 49
2 lamps type No. 55
1 Adapter Connector (UG-641/U)
2 Manuals
1 calibration book

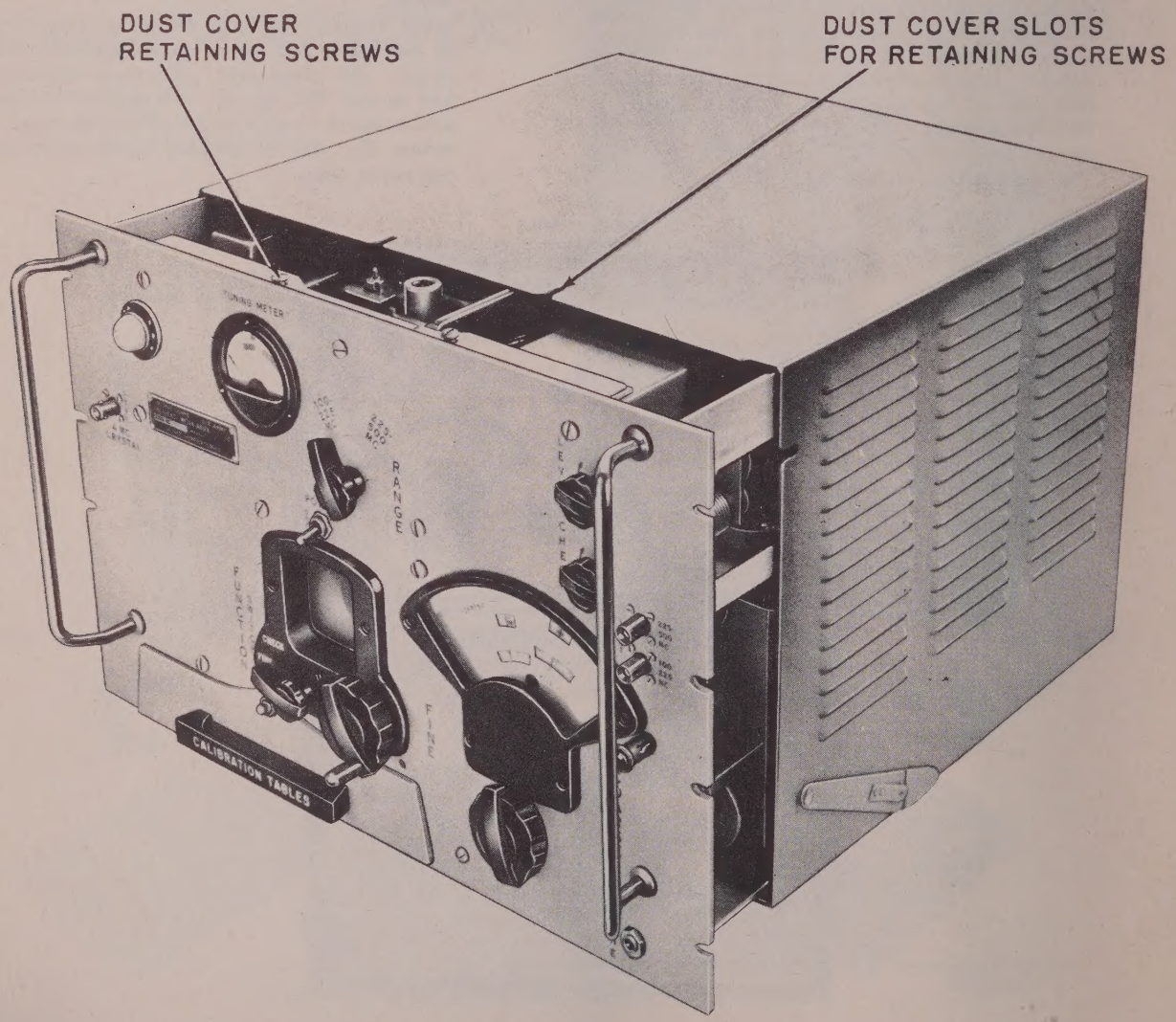


Figure 4. Frequency Meter LA-6, Front View, Partially Pulled From Case

8. Additional Equipment Required

The following equipment is not supplied with the frequency meter but is required for its operation.

1 Headset (HS-30)

1 antenna wire, insulated, 18 inches long (approx)

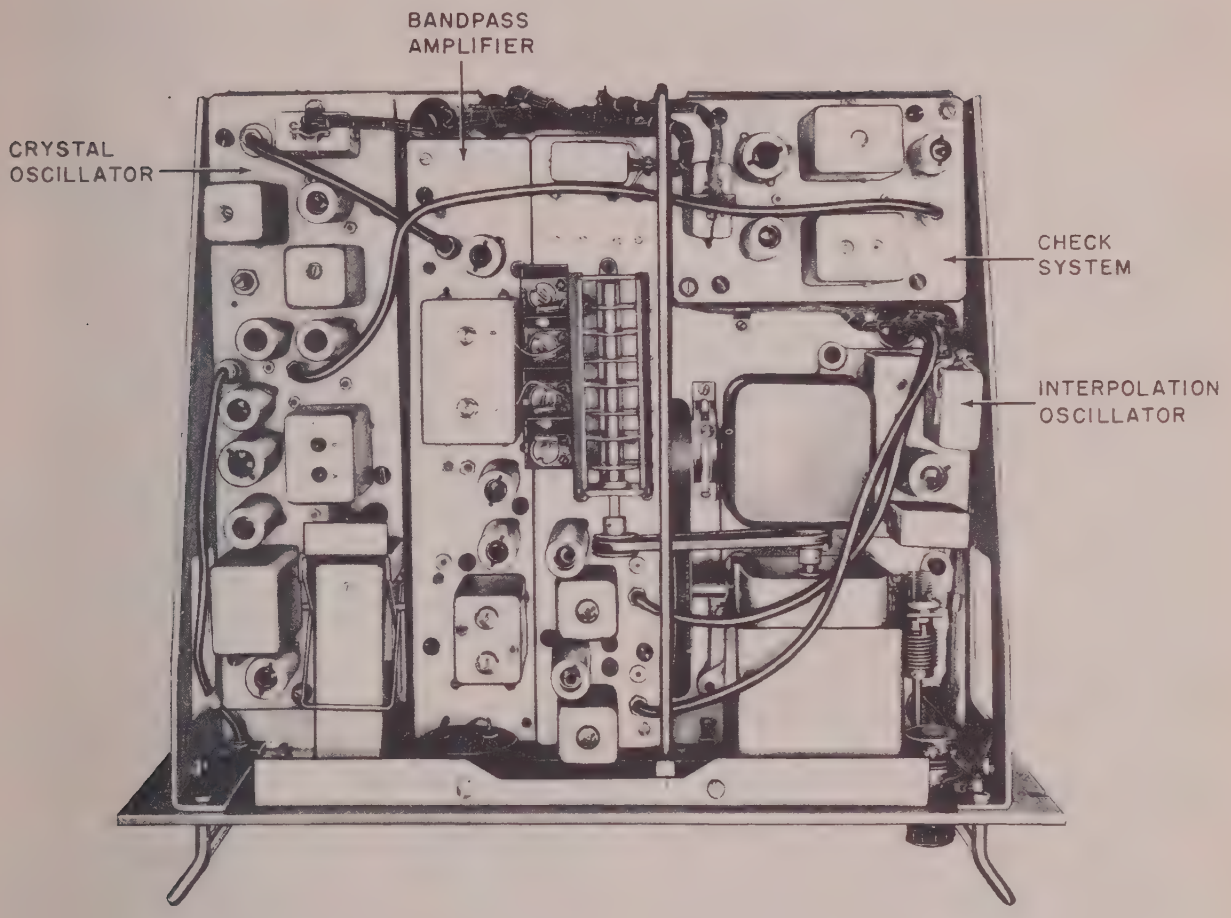


Figure 5. Frequency Meter LA-6, Top View, Location Of Subassemblies

CHAPTER 2

OPERATION

Note. This chapter locates, illustrates, and furnishes the operator with sufficient information pertaining to the various controls and instruments provided for the proper operation of the equipment.

Section I. SERVICE UPON RECEIPT OF FREQUENCY METER LA-6

9. Uncrating, Unpacking, and Checking New Equipment

NOTE: For used or reconditioned equipment, refer to paragraph 12.

a. General. Equipment may be shipped in oversea packing cases or in its own carrying case. When new equipment is received, select a location where the equipment may be unpacked without exposure to the elements and which is near the permanent or semi-permanent installation of the equipment. The instructions in subparagraph b below apply to equipment shipped in export packing cases, and the instructions in subparagraph f below apply to equipment in domestic packing cases. Aside from checking to be sure that all carrying cases are present and that the equipment is undamaged, no special unpacking and uncrating procedures are necessary for equipment shipped in carrying cases.

CAUTION: Be careful when uncrating, unpacking, and handling the equipment; it is easily damaged. If it becomes damaged or exposed, a complete overhaul might be required, or the equipment might be rendered useless.

b. Step-by-step Instructions for Uncrating and Unpacking Export (fig. 6).

(1) Place the packing case as near the operating position as is convenient.
(2) Cut and fold back the metal bands.
(3) Remove the nails with a nail puller. Remove the top and one side of the packing case. Do not pry off the sides and top; the equipment may be damaged.
(4) Remove the waterproof metal container or moistureproof barrier and any excelsior or corrugated paper covering the equipment. Refer to subparagraph d below for instructions on removing the waterproof metal container.
(5) Remove the equipment from its inner case and place it on a work bench near its final location.
(6) Inspect the equipment for signs of possible damage incurred during shipment.
(7) Check the contents of the packing case against the master packing slip.

c. Opening Cardboard Carton and Waterproof Barrier. No special instructions are needed for opening the waterproof paper barrier and removing the equipment from the cardboard carton.

d. Instructions for Opening Metal Containers. The top of the metal container is soldered to the sides. To open, break the soldered seam by prying the side of the container away from the soldered seam as follows:

(1) Wipe off the excess solder with a soldering iron. Never use a torch because the contents of the container are inflammable.
(2) With a wooden block and a screw driver, pry the sides from the soldered seam.
(3) When the seam is completely open, pry off the cover.
(4) Remove the bags of desiccant and protective cardboard packing and lift out the unit.

e. Checking. Check the contents against the master packing slip.

f. Unpacking Domestic Packing Cases. Frequency Meter LA-6 may be received in domestic packing cases. The instructions given in subparagraph b above apply also to unpacking domestic shipments. Cut the metal bands. Open the cartons that protect the equipment; or if heavy wrapping paper has been used, remove it carefully and take out the components. Check the contents of the packing case against the master packing slip.

NOTE: Save the original packing cases and containers for both export and domestic shipments. They can be used again when the equipment is repacked for storage or shipment.

10. Installation of Equipment

This equipment is portable and can be installed or mounted wherever a suitable alternating-current (ac) power source is available. When installing the frequency meter, be sure it is rigidly supported and protected against rain or other adverse weather conditions. When installing the equipment at a permanent location, be sure the equipment controls are within easy reach of the test bench and the equipment to be tested. Over-all dimensions of the equipment are shown in figure 7.

a. Place the frequency meter close to the equipment being tested.

b. If desired, set the frequency meter up on the tilt plate by reaching under the frequency meter and pulling the tilt plate forward.

CAUTION: Unless otherwise tagged, the frequency meter is shipped with the 110V-220V switch S101 in the 110V position. If the switch is set for 110-volt operation and the power cord is connected to a 220-volt outlet, the line fuses (on the rear panel) will blow (POWER switch on). On the other hand, if the switch is set for 220-volt operation and the power cord is connected to the 110-volt source, the line fuses will not blow, but the equipment will be inoperative and the dial lamp will glow dimly.

c. Connect the power cord to a suitable power out-

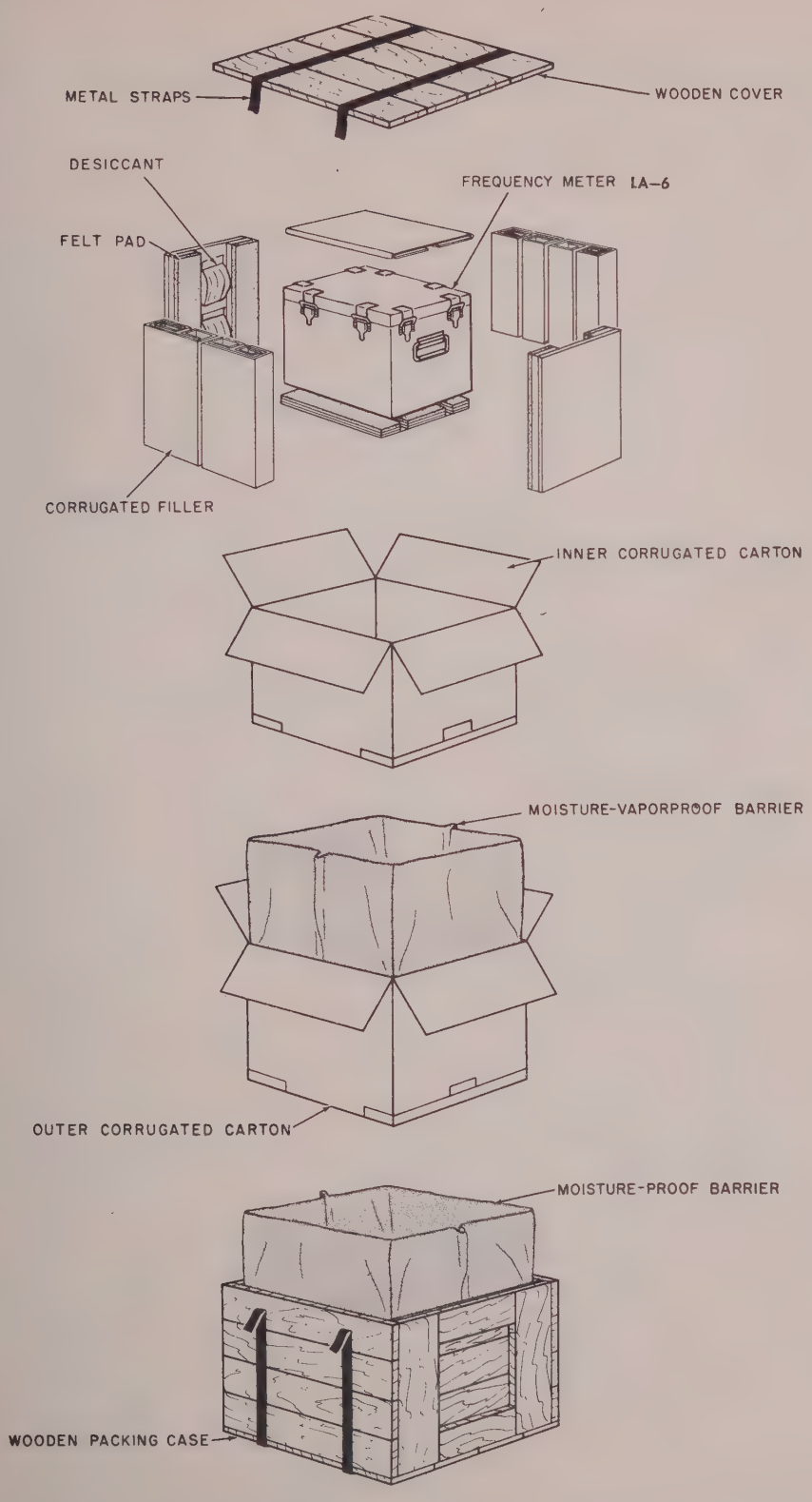


Figure 6. Typical Unit Packed For Export Shipment

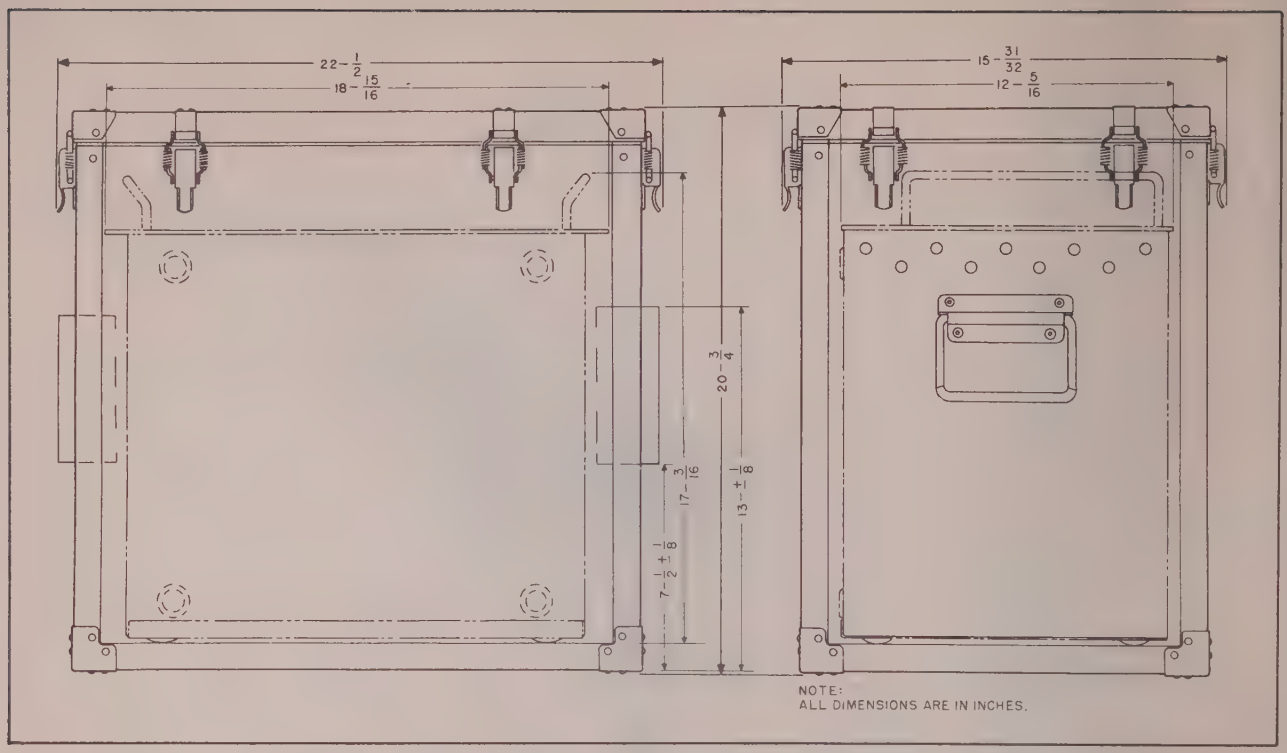


Figure 7. Frequency Meter LA-6, Outline Dimensional Drawing

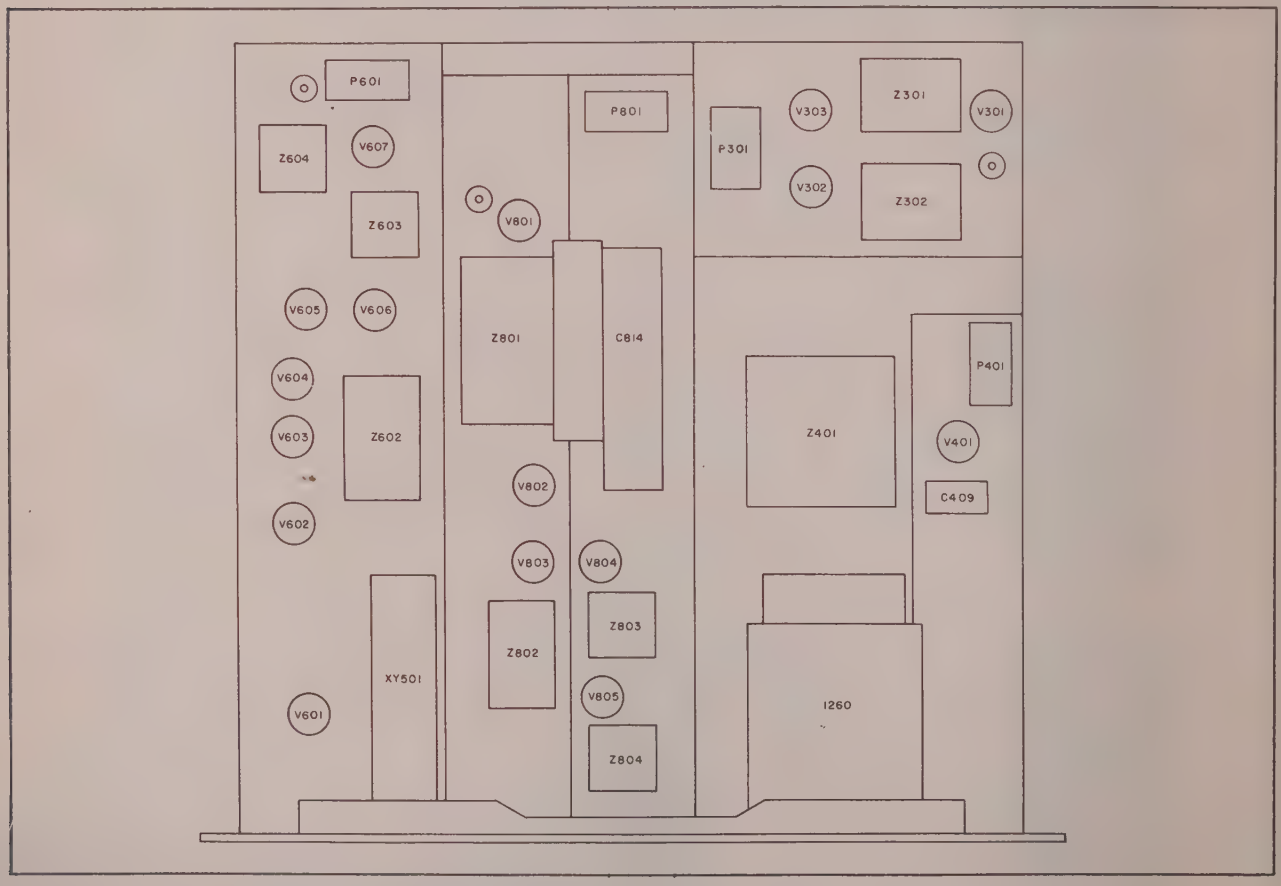


Figure 8. Frequency Meter LA-6, Topview, Tube Location Diagram

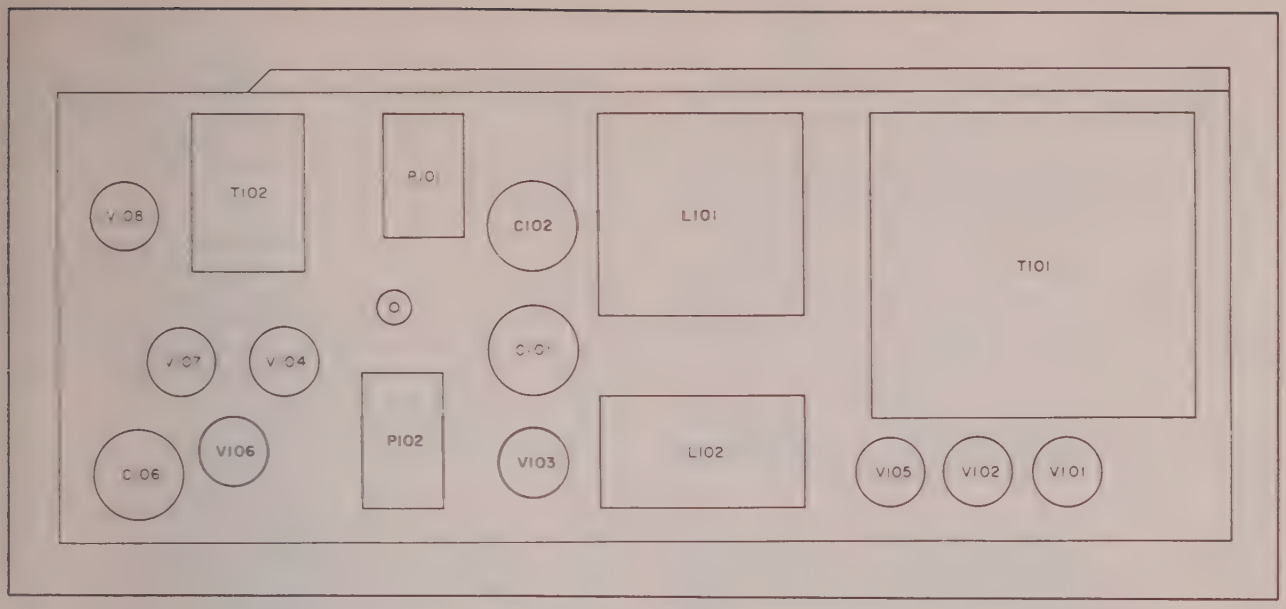


Figure 9. Frequency Meter LA-6, Left Side View, Tube Location Diagram

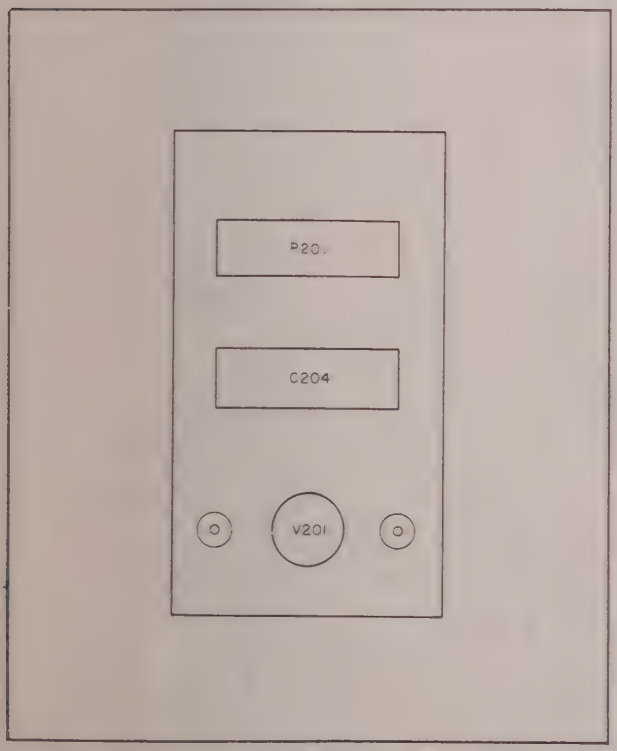


Figure 10. Frequency Meter LA-6, Right Side View, Tube Location Diagram

let (110 or 220 volts, 50 to 1,000 cycles per second (cps)).

d. To reset the frequency meter for operation on a 220-volt power source from operation on a 110-volt power source (or vice-versa), proceed as follows:

(1) Disconnect the power cord.
(2) Remove the dust cover.
(3) Push back the guard from toggle switch S101 (fig. 35); reset the switch to the desired position and replace the lock in its original position.
(4) Reinstall the dust cover.
(5) If switch S101 is set for 220-volt operation, tag the equipment.

e. Vacuum tubes are shipped in position in their respective subchassis. Check the proper installation of tubes against figures 8, 9, and 10.

11. Service upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 10 for uncrating, unpacking, and checking the equipment.

b. Check the used or reconditioned equipment for tags or other indications pertaining to changes in the wiring of the equipment. If any changes in wiring have been made, note the changes in this manual, particularly on the circuit label, over-all schematic, and other wiring diagrams.

c. Check the operating controls for ease of rotation.

d. Perform the installation and connection procedures given in paragraph 10.

12. General

Frequency Meter LA-6 is a precision instrument used to measure accurately any frequency within its operating range. Optimum performance depends upon proper use and interpretation of all controls and indicators. It is important to know the function of each control and its indicator. Refer to figures 11 and 12.

13. Controls and Their Uses

The following chart lists the controls and instruments of Frequency Meter LA-6 and explains their functions.

Control	Function
POWER switch	In the on position, connect frequency meter to ac power source
110V-220V switch	Connects primaries of power transformer T101 in series or in parallel, depending on whether equipment is drawing its power from a 220- or 110-volt ac source.
RANGE switch	Selects desired frequency band. Has two positions (one for each band). Band I 100-225 MC. Band II 225-500 MC.
FUNCTION switch	Selects mode of operation for each step in determining unknown frequency. CHECK position allows operator to calibrate interpolation oscillator against stable crystal oscillator by the CHECK control, see below. The check circuit signal output is connected to the audio-amplifier circuits. COARSE position allows operator to adjust COARSE control to approximate frequency of unknown signal. FINE position allows the operator to adjust the FINE control for precise measurements of unknown frequency.
CHECK control	Calibrates interpolation oscillator to film strip by zero-setting it against crystal oscillator as indicated on TUNING METER.

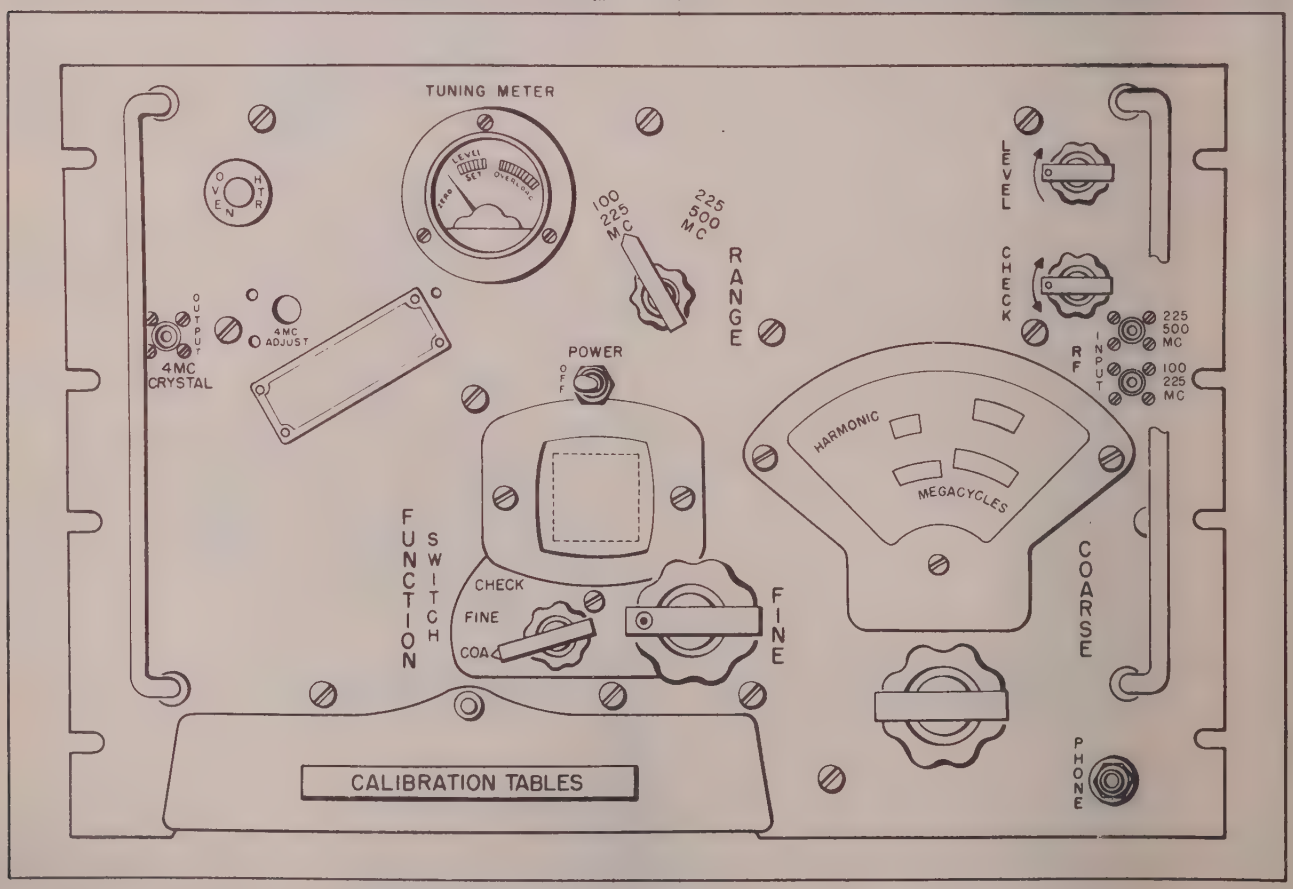


Figure 11. Frequency Meter LA-6, Front Panel

Control	Function
COARSE control	Adjust rf tuner to approximate frequency of signal under measurement. This control also turns floating dial that indicates harmonic of standard basic frequency being used and approximate frequency of unknown signal in megacycles.
FINE control	Tunes capacitor C403 in interpolation oscillator and capacitor C814 in band-pass amplifier to a frequency, a known harmonic of which will be the exact frequency of unknown signal. This control also turns film strip and activates movable index.
LEVEL control	Determines output signal level as indicated by panel meter by controlling input signal level to audio amplifier

Control	Function
4 MC ADJUST	Trims the crystal oscillator frequency to exactly 4 mc when being compared with a known frequency standard.
TUNING METER	Provides visual indications of a zero beat and indicates output signal level.
Film strip	Is viewed through a window with magnifying lens on panel. It indicates interpolation - plus - crystal oscillator frequency.
COARSE tuning dial	The movable index on mask geared to FINE tuning knob, coincides with correct harmonics number in dial, driven by COARSE tuning knob, when measurement is complete. The approximate frequency is shown in megacycles by the fixed index on the glass plate.

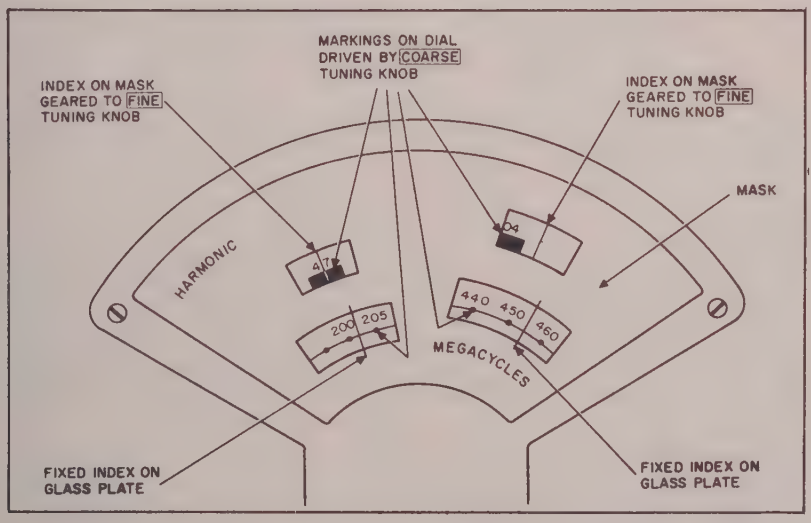


Figure 12. COARSE tuning dial

14. Starting Procedure

Perform the starting procedure given below before using the operating procedure described in paragraph 15.

CAUTION: Be sure S101 located on the power supply chassis is in the correct position, depending on whether the power source is 110 or 220 volts ac, before inserting the power plug into the line.

a. Preliminary. Insert the head phone plug into PHONE jack. Set the front panel controls (fig. 11) as follows:

Control	Position
POWER switch	OFF
FUNCTION SWITCH	COARSE
RANGE switch	Any
CHECK knob	Any
COARSE knob	Any
FINE knob	Any
LEVEL knob	Midposition

b. Starting.
(1) Turn the POWER switch on and allow a minimum 20-minute warm-up period. This is necessary for the crystal oven to reach operating temperature.
(2) Couple the signal to be measured to the appropriate RF INPUT jack.

CAUTION: Do not couple the frequency meter directly to a transmitter output.

15. Operating Procedure for Measurement of an Unknown Frequency
a. Coarse Tuning
(1) Turn the FUNCTION SWITCH to COARSE. Set the RANGE switch to the band within which the approximate unknown frequency lies. The corresponding dial lamp will light.
(2) Rotate the COARSE tuning dial until an audio tone is heard in the headset.
(3) Adjust the LEVEL and COARSE controls to bring the TUNING METER needle to the top of the green area on the dial face. This indicates maximum allowable input to the audio amplifier. It may be necessary to adjust and readjust the two controls. When the signal has been properly adjusted, the rf tuner is turned approximately to the frequency of the unknown signal.
b. Fine Tuning
(1) Turn the FUNCTION SWITCH to FINE. The audio tone will no longer be heard.
(2) Rotate the FINE tuning knob and listen for a tone in the headset. When a tone is heard, it will be a beat note with the frequency decreasing through the audio range to zero and then increasing after passing zero beat. Slowly tune the control for the zero-beat condition.
c. Calibration Check.
(1) Turn the FUNCTION SWITCH to CHECK.
(2) While looking into the FINE tuning window (above the FINE tuning knob), rotate the FINE control until the nearest black diamond-shaped mark is lined up with the hairline on the window. Arrows on the film indicate the direction to the nearest check point. An audio tone will be heard in the headset as the check point is approached.
(3) Turn the CHECK control to lower the frequency of the beat note to zero. As zero beat is approached, it will be necessary to depend upon the TUNING METER for an accurate indication; the needle will oscillate at a decreasing rate and come to rest when zero beat is attained.
d. Final Tuning.
(1) Return the FUNCTION SWITCH to FINE.
(2) Rotate the FINE tuning control until the beat note is heard in the headset. Carefully adjust the FINE tuning knob until a zero beat is heard in the headset and the TUNING METER needle goes to zero or fluctuates slowly.

NOTE: If the signal being measured is not sufficiently stable in frequency, an estimate of zero beat must be made.

e. Determination of Frequency. To determine the frequency, proceed as follows:
(1) Turn to the section of the CALIBRATION TABLES (fig. 13) that coincides with the band indicated on the dial.
(2) Turn to the page number indicated under PG in the FINE tuning window.
(3) Read the basic frequency in the FINE tuning window and locate this number in the column of the CALIBRATION TABLES headed BASIC FREQ.
(4) Locate the HARMONIC column to be used, on the COARSE tuning dial. This is the numbered black rectangle in the illuminated HARMONIC window (fig. 12).
(5) At the intersection of the line containing the basic frequency and the HARMONICS column, read the frequency in megacycles per second. This is the frequency of the signal being measured.

NOTE: The calibration tables are multiplication tables that give the product of basic frequency as found on the film and the harmonic as found on the COARSE tuning dial. If the calibration tables are lost the value of the unknown frequency can be found by performing the multiplication.

16. Operating Procedure for Setting to a Desired Frequency
a. Determination of Dial Settings.

(1) Set the RANGE switch to the desired frequency band.
(2) Turn to the section of the calibration tables corresponding to the selected band.
(3) On page 1 of this section, determine from the first frequency in each HARMONIC column the harmonic which contains the desired frequency. On the same line as this frequency, note the number in the column headed BASIC FREQ.
(4) Rotate the FINE tuning knob until this basic frequency appears in the FINE tuning window.

b. Calibration Check.
(1) Turn the FUNCTION SWITCH to CHECK.
(2) While looking into the FINE tuning window, rotate the FINE tuning knob until the nearest black diamond-shaped mark is lined up with the hairline on the window under CH'K (arrows on the film in the window point in the direction of the diamond). As this diamond-shaped check point is approached, a tone will be heard. Carefully adjust the CHECK knob until this tone goes to zero beat. As zero beat is approached, the TUNING METER needle will oscillate. Zero beat is indicated on the meter when the needle rests at zero.

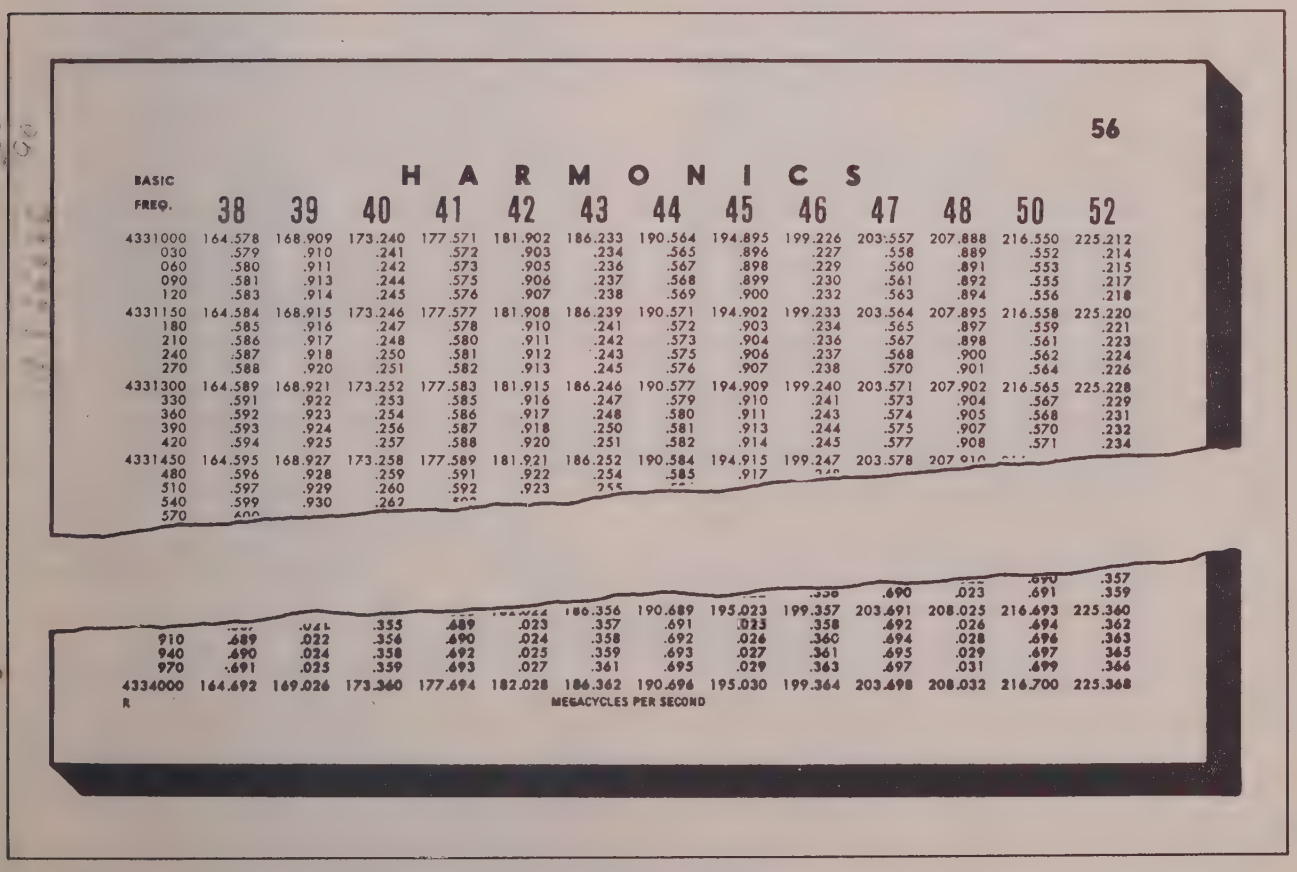
c. Setting to Frequency.
(1) Return the FUNCTION SWITCH to FINE and reset the film in the FINE tuning window to the basic frequency found in subparagraph a above.
(2) Rotate the COARSE tuning knob until the harmonic number found in subparagraph a above is under the hairline in the illuminated HARMONIC window of the COARSE tuning dial.
(3) The frequency meter is now tuned to the desired frequency and may be used as a signal generator as well as a frequency meter.

17. Stopping Procedure
a. Turn the POWER switch to OFF.
b. If no further frequency measurement is to be made, disconnect the rf input cable.

18. Checking Transmitter Frequency
a. Frequency Meter LA-6 can be used to check the frequency of any transmitter whose carrier is in the 100- to 500-mc range. This procedure will determine to an accuracy of .001 per cent whether the transmitter is operating within allowable frequency tolerances. Follow the instructions in paragraphs 15 and 16.

CAUTION: Do not couple the frequency meter directly to the transmitter output.

b. If the transmitter is off frequency, Frequency Meter LA-6 may be used as a standard to retune the transmitter. When the frequency meter is set to the desired frequency (par. 16), tune the transmitter ac-



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BASIC FREQ.	HARMONICS 38	39	40	41	42	43	44	45	46	47	48	50	52
4331000	164.578	168.909	173.240	177.571	181.902	186.233	190.564	194.895	199.226	203.557	207.888	216.550	225.212
030	.579	.910	.241	.572	.903	.234	.565	.896	.227	.558	.889	.552	.214
060	.580	.911	.242	.573	.905	.236	.567	.898	.229	.560	.891	.553	.215
090	.581	.913	.244	.575	.906	.237	.568	.899	.230	.561	.892	.555	.217
120	.583	.914	.245	.576	.907	.238	.569	.900	.232	.563	.894	.556	.218
4331150	164.584	168.915	173.246	177.577	181.908	186.239	190.571	194.902	199.233	203.564	207.895	216.558	225.220
180	.585	.916	.247	.578	.910	.241	.572	.903	.234	.565	.897	.559	.221
210	.586	.917	.248	.580	.911	.242	.573	.904	.236	.567	.898	.561	.223
240	.587	.918	.250	.581	.912	.243	.575	.906	.237	.568	.900	.562	.224
270	.588	.920	.251	.582	.913	.245	.576	.907	.238	.570	.901	.564	.226
4331300	164.589	168.921	173.252	177.583	181.915	186.246	190.577	194.909	199.240	203.571	207.902	216.565	225.228
330	.591	.922	.253	.585	.916	.247	.579	.910	.241	.573	.904	.567	.229
360	.592	.923	.254	.586	.917	.248	.580	.911	.243	.574	.905	.568	.231
390	.593	.924	.256	.587	.918	.250	.581	.913	.244	.575	.907	.570	.232
420	.594	.925	.257	.588	.920	.251	.582	.914	.245	.577	.908	.571	.234
4331450	164.595	168.927	173.258	177.589	181.921	186.252	190.584	194.915	199.247	203.578	207.910		
480	.596	.928	.259	.591	.922	.254	.585	.917					
510	.597	.929	.260	.592	.923								
540	.599	.930	.262										
570													

									.356	.690	.023	.691	.357
													.359
						186.356	190.689	195.023	199.357	203.691	208.025	216.693	225.360
		.021	.355	.689	.023	.357	.691	.023	.358	.692	.026	.694	.362
910	.689	.022	.356	.690	.024	.358	.692	.026	.360	.694	.028	.696	.363
940	.690	.024	.358	.692	.025	.359	.693	.027	.361	.695	.029	.697	.365
970	.691	.025	.359	.693	.027	.361	.695	.029	.363	.697	.031	.699	.366
4334000	164.692	169.026	173.360	177.694	182.028	186.362	190.696	195.030	199.364	203.698	208.032	216.700	225.368

R MEGACYCLES PER SECOND

Figure 13. Frequency Meter LA-6, Calibration Tables, Sample Page

cording to standard procedure. With high-power transmitters, it is not necessary to tune the power amplifier. If the transmitter under check is fm, remove modulation. As the transmitter carrier frequency approaches the frequency meter setting, a beat note will be heard in the headphones and the TUNING METER needle will fluctuate. Continue tuning until zero beat is attained.

19. Receiver Tuning and Alignment

Frequency Meter LA-6 can be used to adjust the alignment of receiver, but is insufficient to align a badly aligned receiver. Thus, its usefulness as a signal generator is limited to final precision alignment. Follow the procedures in paragraph 16 for setting the frequency meter to the desired frequency.

a. To tune receiver to a desired frequency, observe indications of proper tuning by the S-meter of the receiver. Tune the receiver to the preset frequency of Frequency Meter LA-6 by observing the indicating device used with the receiver.

b. If the receiver is to be aligned, refer to the alignment instruction for the receiver; use Frequency Meter LA-6 as the signal generator.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

20. General

The operation of Frequency Meter LA-6 may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc. prevail. Adverse conditions may cause errors in measurements unless additional precautions are taken. Paragraphs 21 through 23 contain procedures for minimizing the effects of unusual climatic conditions.

21. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather affect the efficient operation of test equipment. Instructions and precautions for operation under adverse conditions follow:

a. Handle the frequency meter carefully.

b. Keep the equipment warm and dry, and, if necessary, construct an insulated box for the frequency meter. Keep the tube filaments lighted constantly. To conserve heat, place a blanket over the frequency meter when it is not in use.

c. Remove the instrument from its case for service in a heated inclosure, where there is no danger of a cold draft striking the glass tubes when a door is opened. A sudden draft of cold air is often sufficient to shatter the glass envelope of the tube. If drafts cannot be prevented, place a blanket or some other buffer between the source of the draft and the equipment.

d. When equipment that has been exposed to the cold is brought into a warm room, it will sweat until it reaches room temperature. When the equipment has reached room temperature, dry it thoroughly with rags; use a blower for the inaccessible areas. This condition also arises when the equipment warms up during the day after exposure during a cold night.

22. Operation in Tropical Climates

When operated in tropical climates, test equipment may be installed in tents, huts, or, when necessary, in underground dugouts. When equipment is installed below ground or set up in swamp areas, moisture conditions are more acute than normal in the tropics. Ventilation is usually very poor, and the relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than the ambient air. To minimize this condition, place lighted electric bulbs under the equipment.

23. Operation in Desert Climates

a. The main problem arising with equipment operation in desert areas is the large amount of sand, dust, or dirt that enters the moving parts of test equipment. The ideal preventive precaution is to house the equipment in a dust-proof shelter. Since such a building is rarely available and would require air conditioning, the next best precaution is to make the buildings in which the equipment is located as dust-proof as possible with available materials. Hang wet sacking over the windows and doors. Cover the inside walls with heavy paper, and secure the sidewalls of tents with sand to prevent their flapping in the wind.

b. Never tie power cords, signal cords, or other wiring connections to either the inside or the outside of tents. Desert areas are subject to sudden wind storms which may jerk the connections loose or break the lines.

c. Keep the equipment as free from dust as possible. Make frequent preventive maintenance checks. Pay particular attention to the condition of the lubrication on the gear trains. Excessive amounts of dust, sand, or dirt that comes into contact with oil and grease results in grit, which will damage the equipment.

d. A drastic fall in temperature after sundown often causes condensation. To prevent this, cover the equipment with tarpaulin or similar covering material.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE

Section I. LUBRICATION

24. Lubrication Instructions

a. Only the gears in this equipment require lubrication. The type of lubricant to be used is Aero Lubriplate. The interval and specific instructions for lubricating the moving parts of the test set are shown in figure 14 and listed in subparagraphs b through f below. Refer to figures 42 and 43 for exploded views of all gears requiring lubrication.

b. Gasoline will not be used as a cleaning fluid for any purpose. When the frequency meter is overhauled or repairs are made, clean the parts with a cleaning compound.

c. Carbon tetrachloride will be used as a cleaning fluid only on electrical equipment where inflammable solvents cannot be used because of fire hazard and for cleaning electrical contacts including plugs, jacks, and film mechanism.

CAUTION: Do not allow carbon tetrachloride to contact film, as the protective coating may be damaged.

d. Do not use excessive amounts of oil or grease, and do not allow connections to become greasy.

e. Be sure that lubricants and points to be lubricated are clear and free from sand, grit, or dirt. Use a cleaning compound to clean all parts. Before lubrication, clean all surfaces to be lubricated; use a lint-free cloth dampened with a cleaning compound. Keep the compound off surrounding parts.

f. Lubrication should be performed only when the equipment is disassembled for repairs.

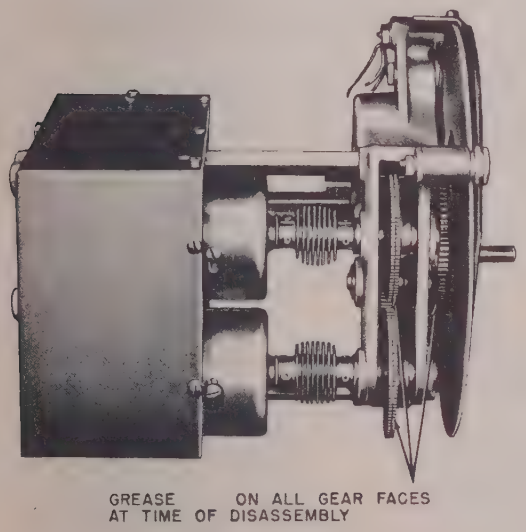


Figure 14. Typical Lubrication Points

25. Lubrication under Unusual Conditions

a. Arctic Region. The lubricant used in Frequency Meter LA-6 (Aero Lubriplate) is of such quality that it is usable in all types of weather and under all climatic conditions. There should be no deterioration of performance of moving parts in arctic regions caused by the lubrication.

b. Tropical Regions. High temperatures and moisture caused by rain, condensation, etc., may cause lubricants which are normally satisfactory to flow from moving parts and other surfaces. These bearing surfaces will wear excessively, and hinges, fasteners, and other parts will be damaged or destroyed by rust and corrosion. Inspect the equipment frequently and lubricate it as required to insure efficient operation.

c. Desert Regions. Dust and sand infiltration into the equipment causes grit in the lubricants and will seriously impair and damage the moving parts of the frequency meter. Hot, dry temperatures cause the lubricants to flow from the moving parts, and conditions similar to those described in subparagraph b above will result. Inspect the equipment frequently and lubricate it as required to insure efficient operation.

Section II. TROUBLE SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

26. General Trouble-shooting Information

a. The trouble shooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) is necessarily limited in scope by the tools, test equipment, and replaceable parts issued, and by the existing tactical situation. Accordingly, trouble shooting is based on the performance of the equipment and the use of the senses in determining such troubles as burned-out fuses, broken cords, defective tubes, cracked insulators, etc.

b. The paragraphs which follow in this section help in determining which of the circuits is at fault and in localizing the fault in the circuit to the defective stage or item, such as a tube or fuse.

27. Visual Inspection

a. Failure of this equipment to operate properly usually will be caused by one or more of the following faults:

(1) Improperly connected power cord to power

source.
(2) Worn, broken, or disconnected cords or plugs.
(3) Burned-out fuses.
(4) Wires broken because of excessive vibration.
(5) Defective tubes.
(6) Inactive oscillator crystal.
(7) Burned-out crystals in the rf tuner.

b. When failure is encountered and the cause is not immediately apparent, check as many of these items as is practicable before starting a detailed examination of the component parts of the system. If possible, obtain information regarding performance from the operator of the equipment at the time trouble occurred.

28. Trouble Shooting by Using Equipment Performance Check List

a. General. The equipment performance check list (par. 29) will help the operator to locate operational troubles within the equipment. The list gives the item checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures the operator can take. To use this list, follow the items in numerical sequence.

b. Action or Condition. For some items, the information given in the Action or condition column consists of various switch and control settings under which the item is to be checked. For other items it represents an action that must be taken to check the indication given in the Normal indications column.

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator should perceive when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those the operator can make without turning in the equipment for repairs. A reference in the list to paragraph 48, Trouble-Shooting Chart, indicates that the trouble cannot be corrected during operation and that trouble shooting by an experienced repairman is necessary. If the set is completely inoperative or if the recommended corrective measures do not yield results, trouble shooting is necessary.

29. Equipment Performance Check List

The equipment performance check list provides information that enables the operator to make a rapid performance check of the frequency meter. Properly used, these checks may eliminate careless and haphazard use of the equipment, which may lead to a major breakdown or cause the equipment to produce incorrect measurements.

a. The items listed under preparatory include all actions and checks which should be made before starting the equipment.

b. The items listed under start include all actions taken during the starting procedure.

c. The items listed under equipment performance include all checks that can be made while the equipment is in operation.

d. Under stop, the items include all actions necessary to shut down the equipment.

	Item No.	Item	Action or Condition	Normal Indications	Corrective Measures
PREPARATORY	1	POWER switch (S702)	Set to OFF position.		
	2	RANGE switch (S801)	Set to desired band.		
	3	CHECK control (C402)	Set to midposition.		
	4	LEVEL control (R701)	Set to midposition.		
	5	FUNCTION SWITCH (S701)	Set to COARSE position.		
	6	COARSE control (C502, C503)	Set to approximate frequency.		
	7	FINE control (C403 and C814)	None.		
	8	PHONE jack (J703)	Plug in earphones.		
START	9	POWER switch (S702)	Set to on position.	One of the coarse tuning dial lamps lights.	Check fuses F101, F102, ac power source, dial lights I701, I702, I703, I704.
EQUIPMENT PERFORMANCE	10	RF INPUT jacks J702, J704	Apply signal to be measured to appropriate jack.		

	Item No.	Item	Action or Condition	Normal Indications	Corrective Measures
EQUIPMENT PERFORMANCE	11	RANGE switch (S801)	Set to proper band for unknown signal frequency.	Amber or green lamp will light depending on setting.	Check dial lamps I701, I702.
	12	Crystal oven lamp I601	Observe lamp.	Cycles on and off. Lights when OVEN HTR is drawing current.	Check lamp I601.
	13	CORASE control (C502, C503)	Adjust to approximate frequency.	Indication on tuning meter. Constant frequency tone should be heard.	Set RANGE switch properly. Refer to paragraph 48.
	14	LEVEL control (R701)	Set for proper level.	Pointer of TUNING METER should be on green LEVEL SET portion of meter face.	Refer to paragraph 48.
	15	FUNCTION SWITCH (S701)	Set to FINE.	Audio note in headset will disappear.	Refer to paragraph 48.
	16	FINE control (C403, C814)	Rotate control.	Film strip will rotate. Audio note will be heard as the unknown frequency is approached. Pitch of tone will decrease as zero beat is approached and increase after it is passed.	Refer to paragraph 48.
	17	Film Strip	Read frequency on right side of film strip in window.		
STOP	18	POWER switch (S702)	Set to OFF.	All dial lamp and indicator lamps go out.	Check switch (S702).

CHAPTER 4

THEORY

30. General

The instrument is a heterodyne frequency meter with two bands that cover 100 to 225 mc and 225 to 500 mc. It can be used to measure the frequency of any am or unmodulated fm carrier. When the FUNCTION SWITCH is set in the COARSE position, the signal to be measured is applied to the appropriate rf tuner, which is tuned to resonance by the COARSE tuning control. The exact resonance is indicated by the TUNING METER. The approximate signal frequency is indicated on the COARSE tuning dial. The signal is modulated by an audio oscillator in order to facilitate tuning. After detection, the audio component of the signal is applied to an audio-frequency amplifier whose output feeds the PHONE jack. Maximum output will indicate exact resonance. The COARSE tuning control also sets the hairline in the HARMONIC window on or near the proper harmonic block. When the FUNCTION SWITCH is set to the FINE position, a standard variable frequency is generated. This is accomplished as follows: the output of a 4-mc crystal oscillator is mixed with the output of the interpolation oscillator, which is variable from 166 to 340 kc/sec and produces a variable signal between 4.166 to 4.340 mc. The signal is amplified and applied to a harmonic generator, which produces harmonics in the applicable frequency range. The interpolation oscillator is tuned by the FINE control; this control is also coupled by mechanical arrangements to the film system, the band-pass tuner, and the COARSE tuning dial hairline. As the frequency of the interpolation oscillator is varied and is added to the crystal frequency, the band-pass tuner, which has a very narrow band-pass characteristic, is automatically resonated at the sum frequency. At the same time, the hairline in the HARMONIC window is slowly moved toward the proper harmonic block. When the sum frequency is such that a harmonic of it is within audible range of the frequency of the signal under measurement, a beat note will be produced in the headphones, and when this is reduced to zero, the standard basic frequency is read directly from the film system and the order of the harmonic is obtained from the harmonic scale. The product of the basic frequency and the order of the harmonic is equal to the frequency of the signal under measurement. When the FUNCTION SWITCH is in the CHECK position, the interpolation oscillator is calibrated by heterodyning the harmonics of this oscillator with the second harmonic of the crystal oscillator. Check points (which are exact submultiples of 8 mc) are marked on the calibrated film strip.

31. Block Diagram (fig. 15, 16, 17)

Subparagraphs a through i below contain a discussion of each stage that explains its function in the equipment. A block diagram is shown for each position of FUNCTION SWITCH S701. In figure 15, the stages that are shaded do not function when switch S701 is in the COARSE position. Figure 16 shows the equipment when switch S701 is in the FINE position, and figure 17 shows the equipment when switch S701 is in the CHECK position.

a. Crystal Oscillator. The crystal oscillator consists of 4-mc quartz crystal Y601, amplifier V601, phase inverter V602, and buffer amplifier V603. The crystal is contained in an oven, thermostatically controlled at 75° C (167° F). Phase inverter V602 supplies the feedback that is necessary to sustain oscillation and matches the output of V601 to buffer amplifier V603. Buffer amplifier V603 isolates the oscillator from any load changes that might affect the frequency. The output of the crystal oscillator is applied to the check system and to the balanced modulator.

b. Interpolation Oscillator. The interpolation oscillator circuit consists of tunable oscillator stage V401A and cathode-follower buffer V401B. The oscillator produces frequencies from 166 to 340 kc. Tuning is accomplished by the FINE control, which is mechanically linked to a variable capacitor in the tank circuit of V401A, to a variable capacitor in the band-pass amplifier, and to the film mechanism. The film strip is calibrated in terms of the basic frequency; that is, the sum of the interpolation oscillator and the crystal oscillator frequencies. The output of the interpolation oscillator is applied to the check systems and to the balanced modulator.

c. Balanced Modulator. The balanced modulator, located on the crystal oscillator subchassis, consists of amplifier stage V604, mixer stages V605 and V606, and tuned amplifier V607. Amplifier V604 amplifies the crystal oscillator signal for better mixing with the interpolation oscillator signal. This stage is in use in all three positions of the FUNCTION SWITCH. Mixers V605 and V606 are used only when the FUNCTION SWITCH is in the FINE position. In this mode of operation, the mixers each heterodyne the crystal and interpolation oscillator signals. Amplifier V607 is tuned to pass only one signal in the 4.166 to 4.34-mc band.

d. Band-pass Amplifier. The band-pass amplifier section includes variable tuned amplifier V801, voltage amplifier V802 with its associated power amplifier V804, and frequency doubler V803 with its associated power amplifier V805. The band-pass amplifier is used only when the FUNCTION SWITCH is in the FINE position. The tuning of the plate circuit of variable tuned amplifier V801 is synchronized with the tuning of the interpolation oscillator. As the interpolation oscillator is tuned through its spectrum, amplifier V801 is tuned accordingly, so that only one frequency is passed (the sum of the crystal plus interpolation oscillator frequencies). This frequency becomes the standard basic frequency, known harmonics of which will be used to zero beat against the unknown signal under measurement. Therefore, all other signals generated within the equipment must be suppressed to avoid beating the unknown signal with a spurious harmonic, thereby producing an erroneous reading.

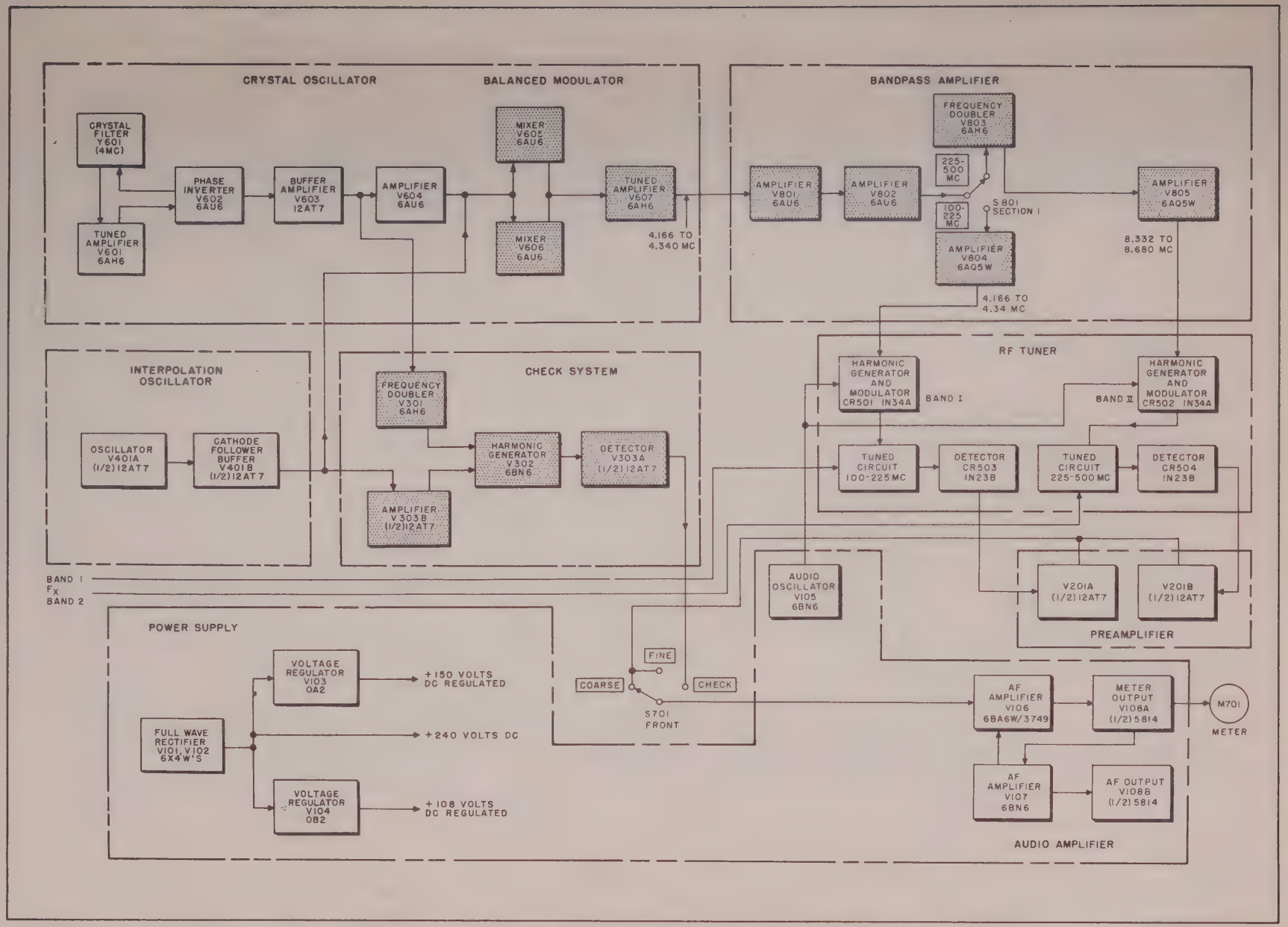


Figure 15. Frequency Meter LA-6, Block Diagram, FUNCTION SWITCH in COARSE position

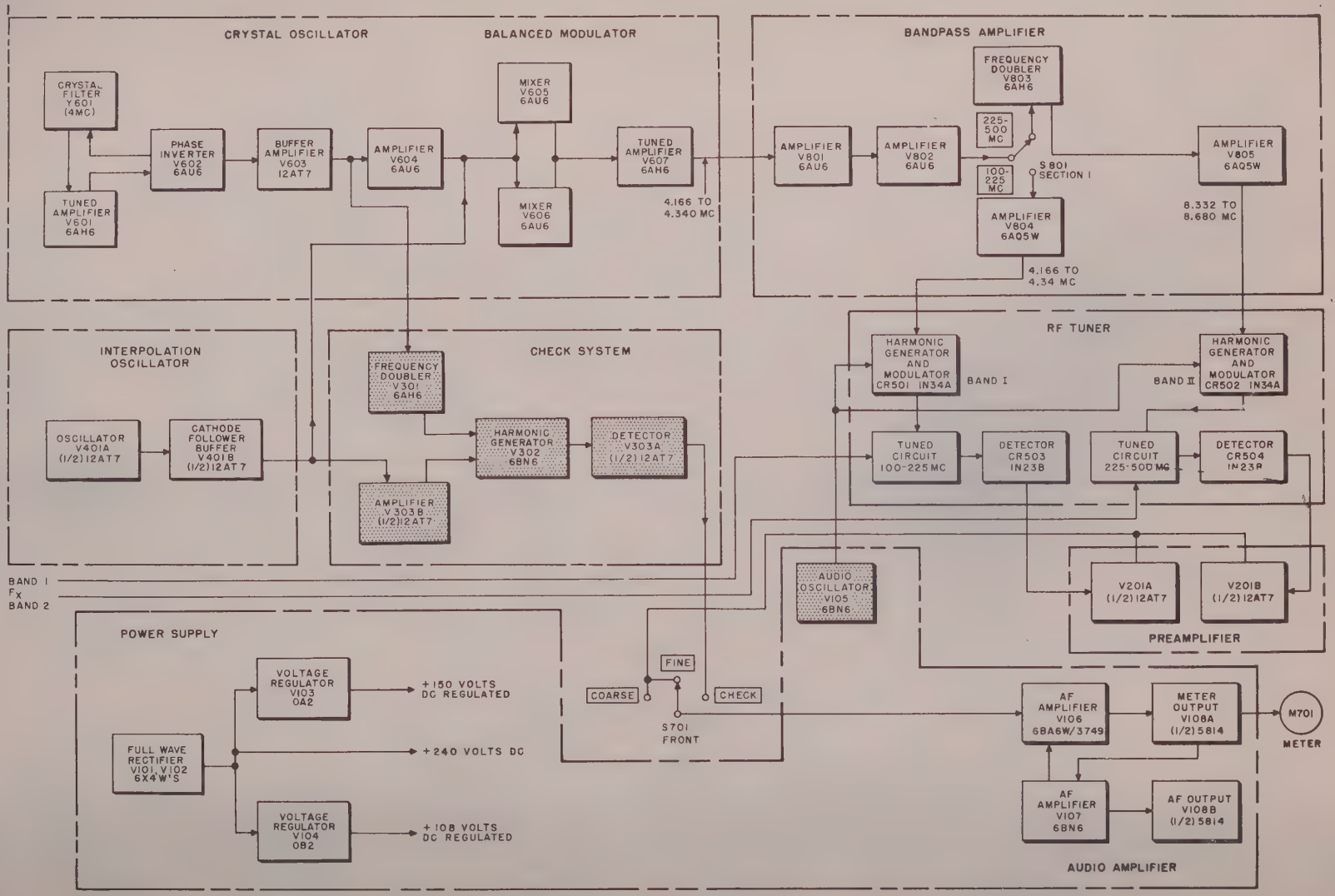


Figure 16. Frequency Meter LA-6, Block Diagram, FUNCTION SWITCH in FINE position

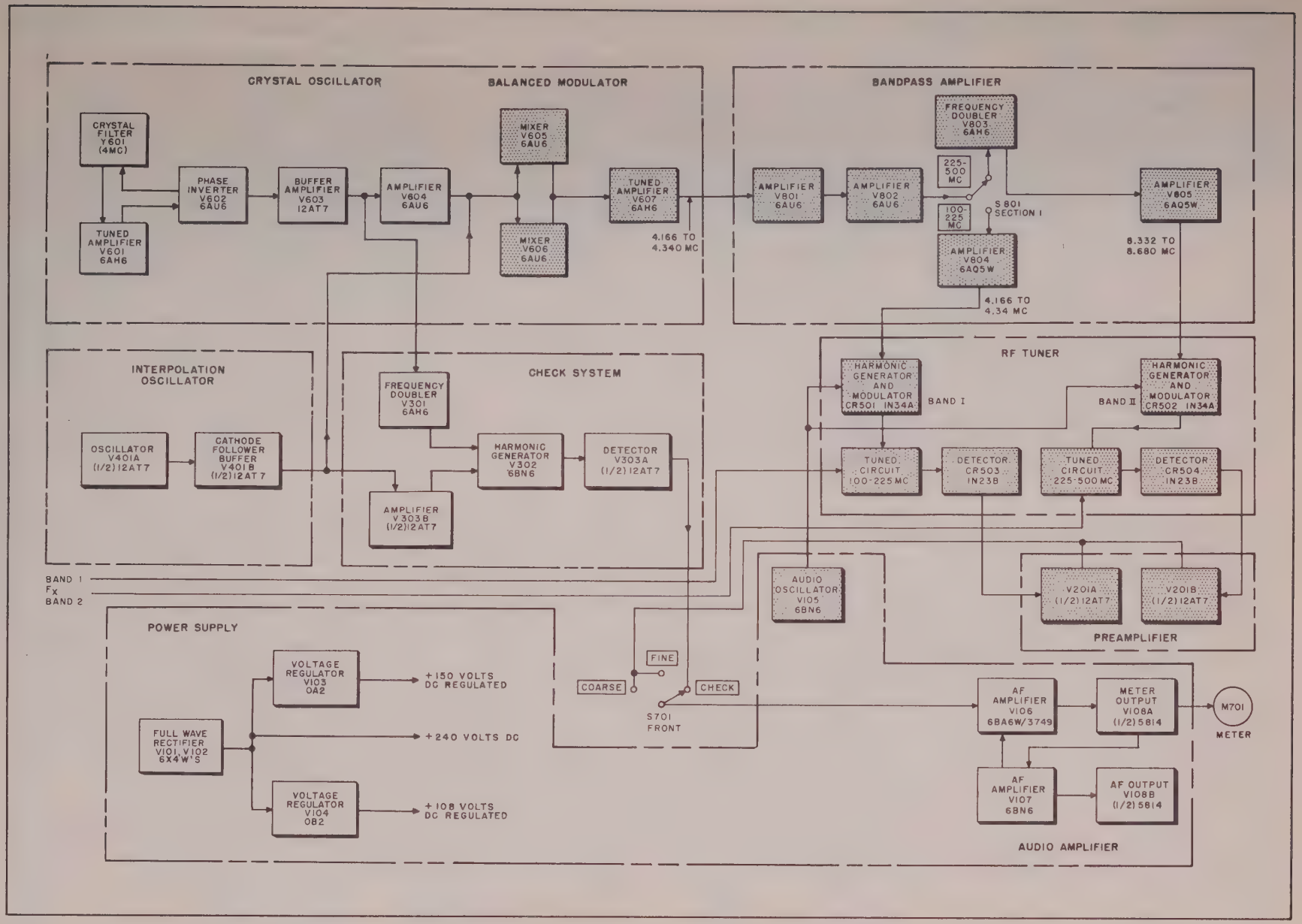


Figure 17. Frequency Meter LA-6, Block Diagram, FUNCTION SWITCH in CHECK position

(1) When RANGE SWITCH S801 is set to the 100-225 MC band, power amplifier V804 is energized and the standard frequency is fed to this stage. Power amplification is necessary so that strong harmonics will be produced in the succeeding harmonic generator crystal for beating with the unknown frequency.

(2) When switch S801 is set to the 225-500 MC band, frequency doubler V803 with its associated power amplifier V805 is energized, and the standard signal is fed to the doubler. The output from the doubler is a signal in the 8.332 to 8.68-mc band. Power amplifier V805 amplifies this signal so that its harmonics, generated in the succeeding harmonic generator crystal, will beat effectively with the unknown signal under measurement.

e. Audio Oscillator. Audio oscillator V105 is a relaxation-type oscillator whose output is an 800 ±300 cps. It modulates the frequency being measured when the frequency meter is being coarse-tuned. Application of plate voltage is controlled by the FUNCTION SWITCH. The audio oscillator functions only when the FUNCTION SWITCH is in the COARSE position.

f. Rf Tuner. The rf tuner assembly comprises the elements required for determining the approximate frequency of the unknown signal (FUNCTION SWITCH in COARSE position) and for producing a heterodyning signal between the unknown and a harmonic of the internally generated standard frequency (FUNCTION SWITCH in FINE position). These functions are accomplished in a dual circuit arrangement one half of which covers the 100- to 225-mc range and the other the 225- to 500-mc range. When the FUNCTION SWITCH is in COARSE position, the audio note from V105 is applied to a crystal across a portion of the rf tuner circuit and is used to modulate the unknown signal applied across a crystal detector. As the rf circuit is coarse-tuned and approaches the unknown, this audio modulation is detected and applied to the preamplifier. When the FUNCTION SWITCH is in the FINE position, the audio signal is removed and replaced by the standard basic frequency output of the band-pass amplifier. Crystal CR1 acts as a harmonic generator for this frequency. As the interpolation oscillator frequency is varied, one harmonic will approach the frequency of the unknown signal. This signal is coupled by the tuned circuit to the detector crystal and mixed with the unknown signal to produce a beat note. The beat note is applied to the preamplifier.

g. Preamplifier. Preamplifier V201 is a twin triode used to raise the level of weak difference frequency signals resulting from heterodyning the standard basic frequency harmonic with the unknown signal. Triode V201B amplifies those signals generated in the 100- to 225-mc section of the rf tuner. Triode V201A amplifies those signals generated in the 225- to 500-mc section of the rf tuner. The output of the preamplifier is fed to the audio amplifier and meter output circuit.

h. Check System. The check system circuit comprises frequency doubler V301, amplifier V303B, harmonic generator V302, and detector V303A. This circuit is energized only when the FUNCTION SWITCH is in the CHECK position. The check system provides for checking the calibration of the interpolation oscillator against the stable crystal oscillator at marked intervals along the film strip. The crystal oscillator frequency is doubled to 8-mc in V301 and applied to harmonic generator V302. The variable-frequency signal from the interpolation oscillator is amplified in V303B and fed to harmonic generator V302. This stage mixes harmonics of the interpolation oscillator signal with the 8-mc signal from doubler V301. As an interpolation oscillator harmonic approaches 8-mc, the difference frequency falling in the audio range is detected by V303A and fed through the audio-amplifier section to the PHONE output. When the harmonic frequency is exactly 8-mc, there is no difference frequency and, accordingly, no audio output.

i. Audio Amplifier and Meter Output Circuit. This circuit consists of V106, V108A, V107, and V108B. When FUNCTION SWITCH S701 is set to either the CHECK or FINE position, an audio signal is fed to the audio amplifier and meter output circuit. When the FUNCTION SWITCH is in the COARSE position, an audio signal is fed to the audio amplifier and meter circuit; it is at its maximum when the COARSE control is properly set. Audio-frequency amplifier V106 is a remote cutoff pentode used to amplify the weak signals applied to it from the preamplifier. The amplified output from V106 is applied to meter output amplifier V108A and audio amplifier V107. Two outputs are taken from V108A. One signal is rectified and used to deflect direct-current (dc) meter M701; the other signal is rectified and used to provide a variable bias for audio amplifier V107. Audio amplifier V107 is a gated amplifier that will cut off unless driven by a signal of sufficient amplitude. This action causes the tube to discriminate against all but the tuned beat frequency. The output signal of V107 is then applied to audio-output stage V108B, where it is amplified and fed to the headphones. The audio amplifier and meter output circuit are located on the power supply subchassis.

32. Crystal Oscillator Circuit

The crystal oscillator circuit provides the highly stable measuring and calibrating signals of the frequency meter. To insure maximum frequency stability, the crystal is inclosed in a temperature controlled oven. The crystal oscillator consists of 4-mc crystal-tuned oscillator amplifier V601. Crystal Y601 generates the 4-mc signal, tube V601 amplifies the signal, and phase inverter V602 feeds the signal back to V601 of the proper phase and amplitude necessary to sustain oscillations. Buffer amplifier V603 isolates the cathode-follower oscillator from the rest of the frequency meter. This prevents oscillator overloading and the resultant frequency instability.

a. Tuned Amplifier V601 (fig. 18). Tuned amplifier V601 uses a 6AH6 tube to provide the necessary amplification. The amplifier plate tuned circuit consists of L601 and fixed capacitor C605, shunted by loading resistor R628. This network is fixed-tuned to 4-mc. Slight adjustments of the network are accomplished by trimmers C603 and C604. The phase of the signal being fed back to V601 via C609 is such that it will sustain oscillation in the circuit. The amplified plate output is applied to the control grid of V602

through C608. Resistor R606 and capacitor C606 form the tuned amplifier plate decoupling network. Screen voltage for V601 is applied through dropping resistor R603, and the screen is bypassed by C602. Cathode bias is furnished by R602 and C601. Resistors R601 and R602 form a voltage-divider network, which reduces the strain across the crystal. The voltage developed across R602 is applied to the control grid of V601.

b. Phase Inverter V602. Phase inverter V602 uses a 6AU6 pentode. The 4-mc signal from the tuned amplifier is coupled to grid resistor R605 by coupling capacitor C608. The amplified and inverted output for V601 is taken from plate load resistor R608. Resistor R611 and capacitor C607 form the plate decoupling network for V602. Screen voltage is applied through screen dropping resistor R609 and is kept at rf ground potential by C611. The output, as well as bias, is developed across R607 and C610. Capacitor C612 is a coupling capacitor that feeds the 4-mc signal to buffer amplifier V603.

c. Buffer Amplifier V603 (fig. 19). Buffer amplifier V603 is a cathode follower that isolates the tuned amplifier-oscillator V601 and phase inverter V602 from the following circuits to avoid oscillator loading and the resultant instability. A common cathode is used for buffer amplifier V603A and grounded grid amplifier V603B. The signal from buffer amplifier V603A is injected into grounded grid amplifier V603B. A grounded grid amplifier is used to isolate the crystal oscillator circuit. Resistor R610 provides the grid return for the buffer amplifier circuit. Resistor R613 is the cathode load resistor for buffer amplifier V603A and the input resistor for V603B. Plate decoupling for V603 is provided by R612 and C613. Resistor R614 is the plate load for V603B. Plate supply voltage for this tube is bypassed by capacitor C636. The output signal is coupled through capacitor C614 to test jack J701, through capacitor C301 to the control grid of doubler V301, and through capacitor C615 to the balanced-modulator circuit.

33. Interpolation Oscillator

The interpolation oscillator is a highly stable inductance-capacitance (lc) oscillator whose frequency can be varied from 166 to 340 kilocycles. It consists of modified Colpitts oscillator V401A, known as a Clapp oscillator, and buffer amplifier V401B. Its output is fed to the balanced modulator.

a. Tunable Oscillator.

(1) The circuit of oscillator V401A is similar to a Colpitts oscillator, with the exception that a series lc circuit replaces the conventional parallel-tuned circuit (B, fig. 20). The series resonant circuit has across it a voltage-divider network consisting of C405 and C406. The grid is connected to one end of this network and the plate to the other end. The ratio of the voltage developed across the divider network determines the amplitude of the feed-back voltage. Thus, a voltage of the proper phase and amplitude

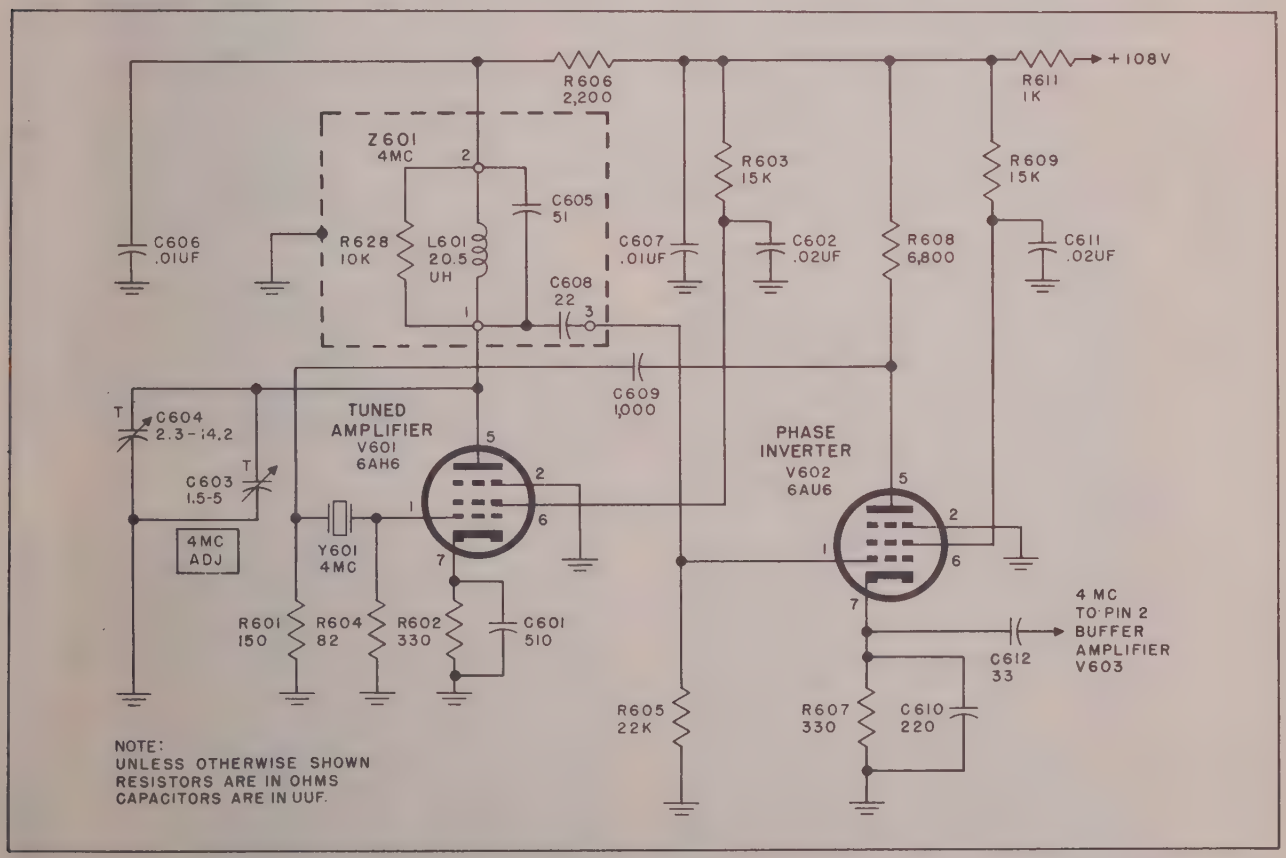


Figure 18. Frequency Meter LA-6, Crystal Oscillator, Simplified Schematic

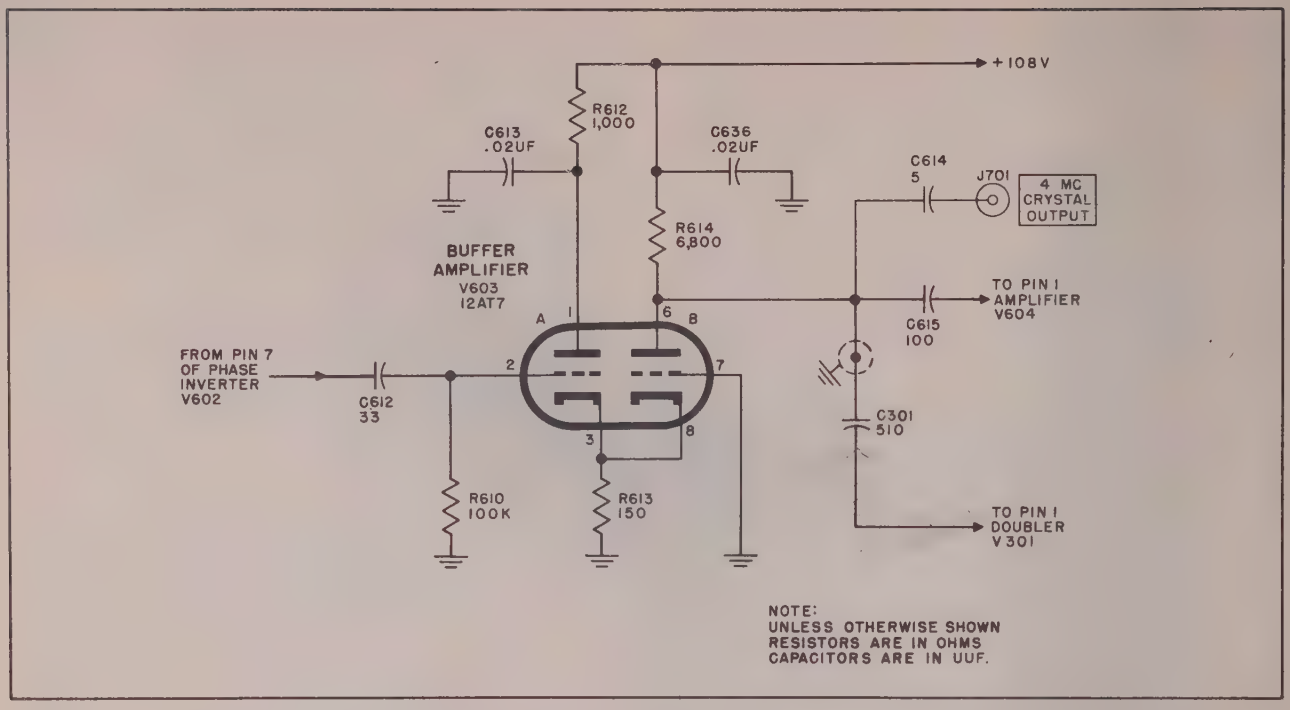


Figure 19. Frequency Meter LA-6, Crystal Oscillator, Buffer - Amplifier Circuit

necessary to sustain oscillations is fed to the grid of the tube. The capacitance values of C405 and C406 are larger than tuning capacitor C_0; therefore, the tube and internal tube capacitances have little loading effect on the resonant frequency of the series-tuned circuit. The resonant circuit (and resonant frequency) is isolated from the tube variables by the capacitance voltage-divider network C405 and C406, resulting in a high degree of frequency stability.

(2) In the actual circuit, shown in A, figure 20, capacitors C410, C401, C402, and C403 are designated C in the equivalent circuit. The tank circuit is composed of these capacitors and inductor L401. Capacitors C405 and C406 form the voltage divider across the series resonant circuit. The voltage developed across C406 is applied to the grid of interpolation oscillator V401A. This voltage sustains oscillations. Grid leak bias is provided for the oscillator by capacitor C407 and resistor R402. Resistor R402 minimizes grid current, which further reduces the loading effect caused by the tube. The rf signal is applied to the grid through capacitor C407. The rf choke in the cathode leg provides the cathode dc return path. Resistor R405 and capacitor C409A form the plate decoupling network. The oscillator is a grounded plate arrangement; no high dc voltages appear at any point in the tank circuit. The oscillator it tuned by the FINE control only when the FUNCTION SWITCH is in the FINE position. The FINE control is linearly geared to C403 and to the film strip. When the FUNCTION SWITCH is in the CHECK position, the oscillator is calibrated at its nearest check point by the CHECK control, which is coupled to C402. A Gilmer timing belt couples C402 and the film mechanism mechanically. The Clapp oscillator is highly stable against changes in temperature, tube reactances, replacement tubes of the same type, and power supply variations. The output is taken from the junction of L401 and the parallel-tuning capacitors and applied through C404 and isolating resistor R401 to the grid of buffer V401B.

b. Buffer Amplifier. Amplifier V401B isolates the oscillator against fluctuations and variations caused by circuit loading. The plate of the buffer is bypassed to ground by C409B. Resistor R403 is the grid return resistor. The output signal is developed across cathode resistor R404 and applied through C408 to the balanced modulator and to V505B in the interpolation oscillator check circuit.

34. Balanced Modulator

The balanced-modulator circuit (fig. 21 and 22) consists of amplifier V604, mixers V605 and V606, and tuned amplifier V607. This circuit effectively adds the interpolation oscillator signal, variable between 166 to 340 kc, to the crystal oscillator 4-mc signal, producing an output signal in the 4.166 to 4.34-mc range. It functions as follows:

a. Amplifier V604. The 4-mc signal from the crystal oscillator circuit, applied to the control grid of V604, is amplified in a conventional pentode amplifier. Resistor R615 is the grid return resistor. Cathode resistor R616 and capacitor C617 provide operating bias. Resistor R617 is the screen dropping resistor and capacitor C616 is the screen bypass. Resistor R618 and capacitor C619 form the plate de-

coupling newtork. Capacitor C618 is an additional bypass to ground; inductance L601 serves as an rf choke in the plate supply circuit. Capacitor C620, across the primary coil of transformer T602, forms the tuned plate tank of V604. The output, taken off the plate of V604 is transformer-coupled by T602 to the grids of mixers V605 and V606.

b. Mixers V605 and V606.

(1) Mixers V605 and V606 use 5725/6AS6-W tubes. Capacitor C623 and the secondaries of permeability tuned transformer T602 form the tuned grid tanks for mixers V605 and V606. The 4-mc signal from amplifier V604 is fed to this tank circuit and to the control grids. Capacitors C621 and C622, and the secondary of transformer T601 provide a tuned circuit for the interpolation oscillator signal that is inductively coupled across T601. The interpolation oscillator frequency is fed to the suppressor grids of mixers V605 and V606. Each tube mixes the input frequencies, producing at their output the sum and difference frequencies. Because of their phase relationship, the original input frequencies cancel each other at the output of V605 and V606. The resultant beat fre-

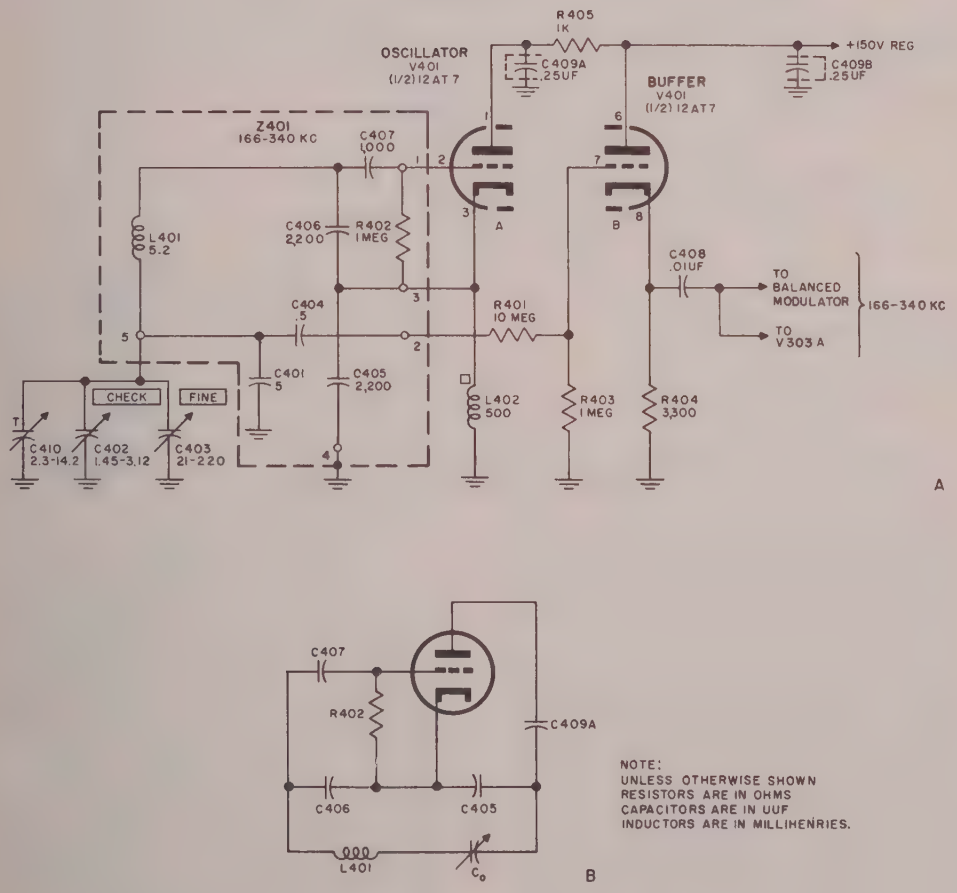


Figure 20. Frequency Meter LA-6, Interpolation Oscillator, Simplified Schematic

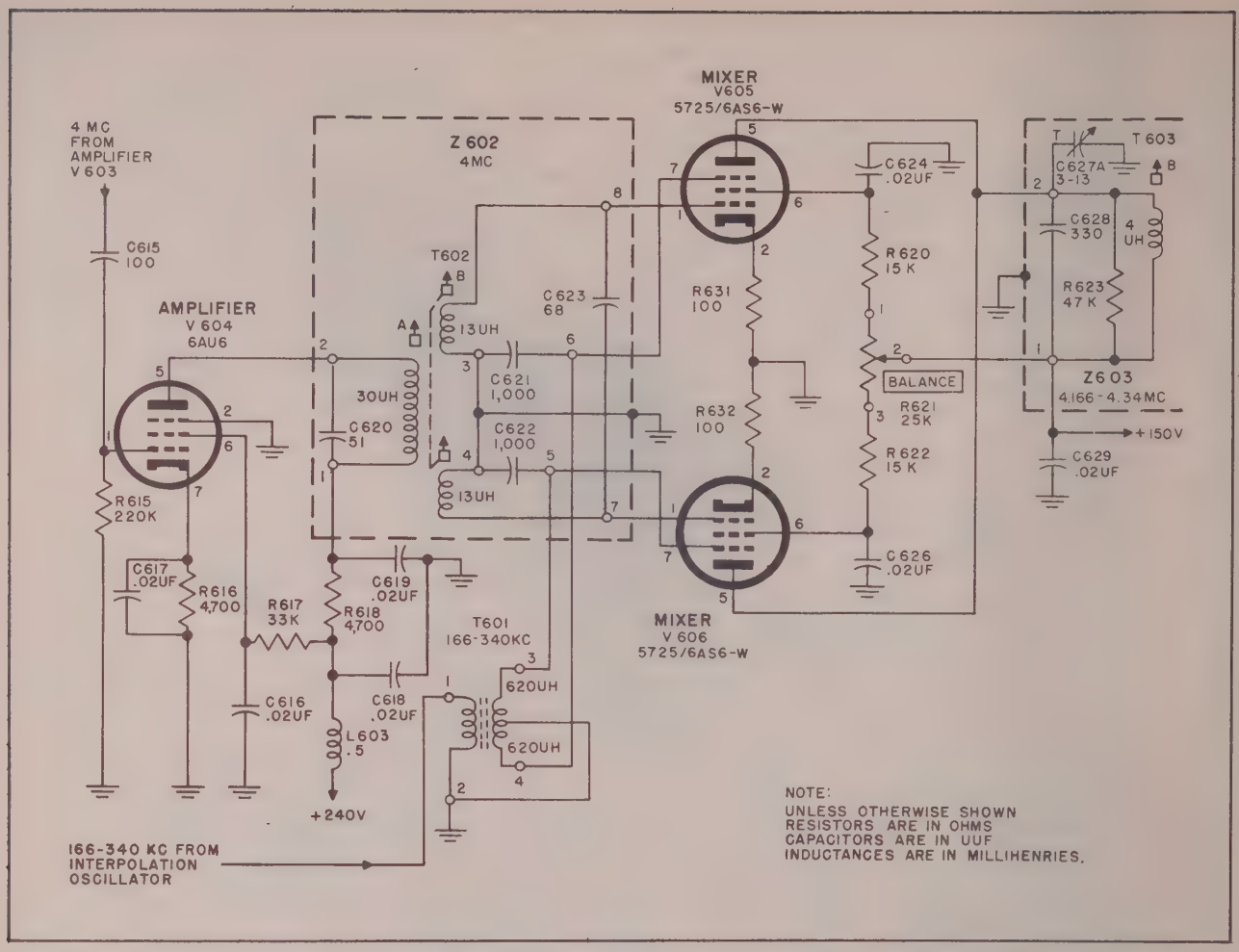


Figure 21. Frequency Meter LA-6, Balanced - Modulator Circuit, Amplifier and Mixers, Simplified Schematic

quencies, however, become additive and are applied to the next stage. Mixers V605 and V606 are pentodes with their input operating push-pull and their output operating push-push.

(2) Cathode bias is provided by R631 for V605 and R632 for V606. Thus, biasing results in easier balancing of the stages. The plates receive a common B+ supply and voltage-dropping resistors R620 and R622 provide the proper screen grid potential. Variable resistor R621 (BALANCE control) maintains a balance between the outputs of V605 and V606. Capacitors C624 and C626 keep the SCREEN grids at an rf ground potential. The plate tank, common to both V605 and V606, is composed of capacitor C628, loading resistor R623, and the primary of permeability tuned transformer T603. Fine tuning is provided by trimmer capacitor C627. Capacitor C629 is a plate bypass to ground. Because the sum is the operational frequency required, the plate tank is tuned to the low end of the 4.166 to 4.340 mc range. This tuned signal then is coupled across transformer T603 to the control grid of tuned amplifier V607 (fig. 22).

c. Tuned Amplifier V607. Because of the inability of the tuned circuit in the plate of V605 and V606 to discriminate completely against all but the wanted frequencies, an additional tuned amplifier stage, V607, is provided. This is a conventional pentode amplifier that uses the identical tuned plate circuit as the preceding mixers, but tuned to the high end of the 4.166- to 4.34-mc range. Resistor R624 and capacitor C631 are the cathode bias resistor and by pass capacitor, respectively. Resistor R625 is the screen dropping resistor and capacitor C632 the screen bypass to ground. Resistor R627 and capacitor C635 form the plate decoupling network. Inductance L602 and capacitor C638, a bypass to ground, further filter the +150-volt plate's supply. The tuned 4.166- to 4.34-mc signal is coupled through capacitor C801 to band-pass amplifier stages V801 and V802.

35. Band-pass Amplifier

The accuracy of Frequency Meter LA-6 depends upon heterodyning a known harmonic of a calibrated signal produced by the meter with the signal under measurement, therefore, every spurious signal must

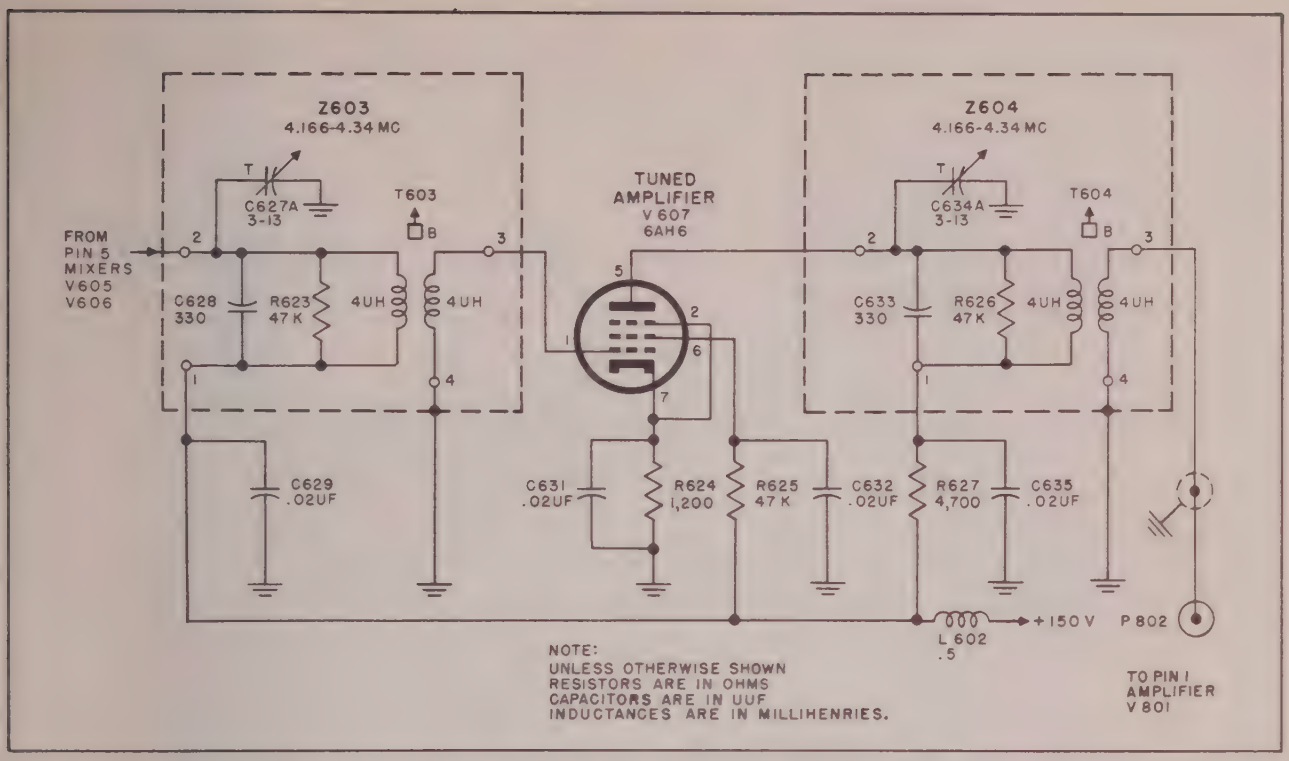


Figure 22. Frequency Meter LA-6, Balanced-Modulator Circuit, Tuned Amplifier, Simplified Schematic

be suppressed that might otherwise mix with the unknown signal to give an erroneous reading. To do this, a band-pass circuit is provided to pass only one signal in the 4.166- to 4.34-mc band. Then the band-pass amplifier circuit amplifies the selected signal in the 4.166- to 4.34-mc band so that its harmonics may be used to measure unknown frequencies in the 100- to 225-mc range, or it doubles and amplifies the input frequency so that harmonics of a selected signal in the 8.332- to 8.68-mc band may be used to measure unknown frequencies in the 225- to 500-mc range.

a. Amplifiers V801 and V802 (fig. 23).

(1) When FUNCTION SWITCH S701 is placed in the FINE position, the band-pass amplifier circuit is energized by the application of positive 240 volts to the plates. The input signal from the balanced-modulator output is connected to J802. This signal in the 4.166- to 4.34-mc range is coupled through C801 to the control grid of amplifier V801 across grid return resistor R801. Input amplifier V801 is a cathode-biasing plate-tuned amplifier. The biasing network is C802A and R802. The plate-tuned circuit consists of the primary of T801, section A of gang-tuned capacitor C814, trimmer capacitor C812, and fixed capacitor C813. Three more identical circuits are used; the output of each is inductively coupled to the following circuit. The inductances are the secondary of T801 and the primary and secondary of T802. Main tuning of the networks is accomplished by sections B, C, and D of gang-tuned capacitor C814; trimmer capacitors C816, C818, and C820, and fixed capacitors C817, C819, and C821 are paired across sections B, C, and D, respectively. This tuned circuit is selective and discriminates against all but the wanted signal.

(2) As the interpolation oscillator frequency is varied through its spectrum, ganged capacitor C814 simultaneously retunes the network to the crystal-plus-interpolation oscillator frequency. This tuned signal is coupled through capacitor C822 to the control grid of amplifier V802. Variable capacitor C815 adjusts the band-pass characteristics of the network.

(3) Amplifier V802 is a conventional pentode amplifier that uses cathode bias developed by R808 and C823A. The plate load consists of resistor R809 and peaking coil L803, used to effect a uniform response characteristic across the 4.166- to 4.34-mc spectrum. The output signal is coupled through C827 and applied to amplifier V804, or doubler V803, depending on whether the frequency meter is used to measure an unknown frequency in the 100- to 225-mc band, or the 225- to 500-mc band, respectively.

(4) Plate supply voltage for V801 and V802 is filtered by C808 and L801. Further filtering is provided by the decoupling networks R806 and C803 for V801 and R811 and C824 for V802. Screen voltage for V801 is supplied through dropping resistor R805 and the

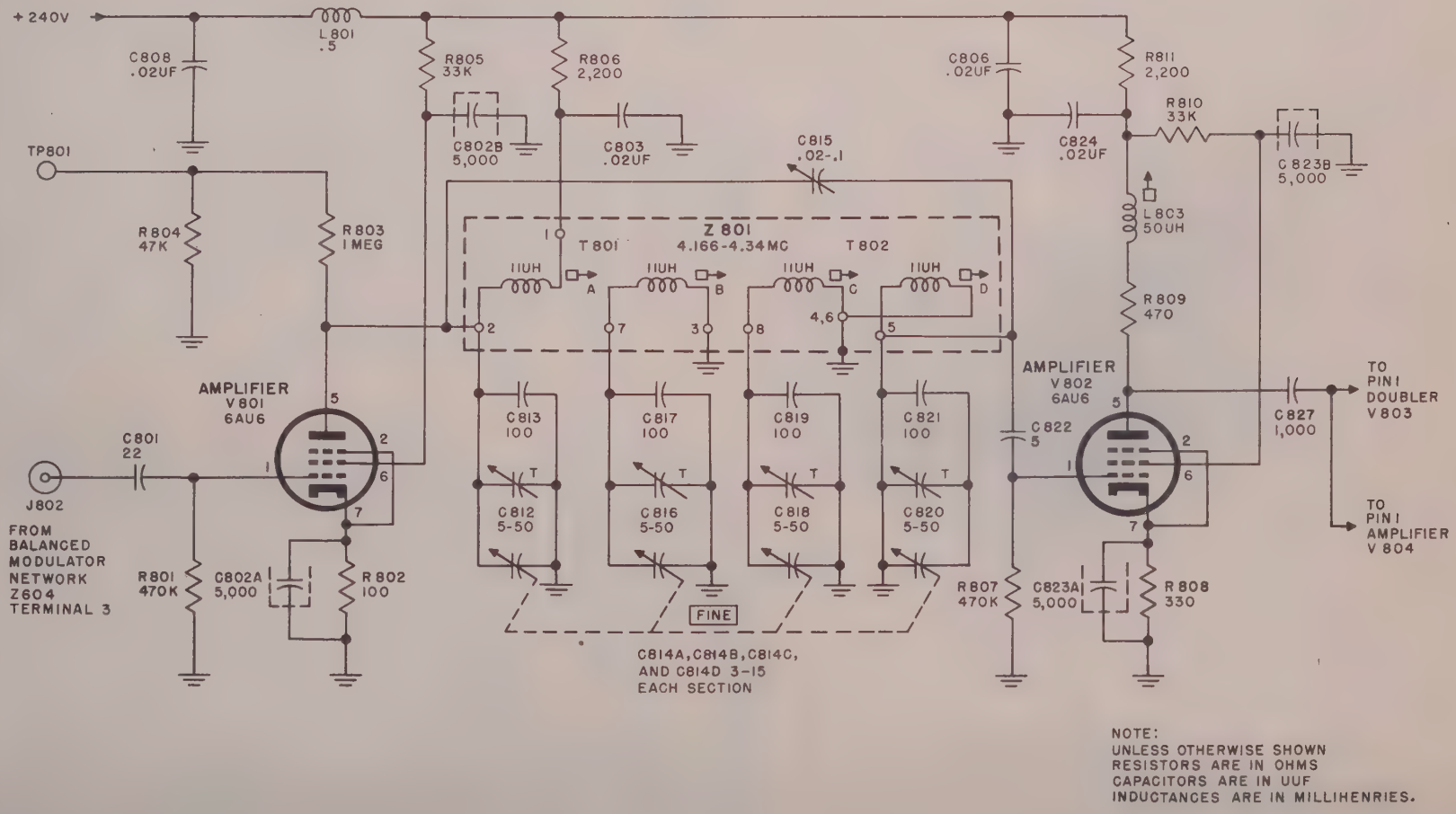


Figure 23. Frequency Meter LA-6, Band-Pass Circuit, Amplifiers V801 and V802, Simplified Schematic

screen is bypassed by C802B. Screen voltage for V802 is supplied through dropping resistor R810 and the screen is bypassed by C823B. A test output is available from the plate of V801 at TP801. This test point is at the junction of voltage divider R803 and R804 in the plate circuit of V801.

b. Doubler V803 (fig. 24).

(1) RANGE switch S801, section 1, energizes either the doubler section or amplifier V804, depending on whether the signal under measurement falls in the 100- to 225-mc or the 225- to 500-mc range. If a 225- to 500-mc signal is to be measured, then the 4.166- to 4.34-mc signal coupled through capacitor C827 is coupled through capacitor C828 to the control grid of doubler V803. Output circuit Z802 is a permeability tuned filter coupling network that is broadly tuned to a flat response across the 8.332- to 8.68-mc spectrum. The network combines four parallel-tuned circuits: primary inductance T803A and capacitor C833 in one parallel-tuned circuit, and T803B and C834 in the

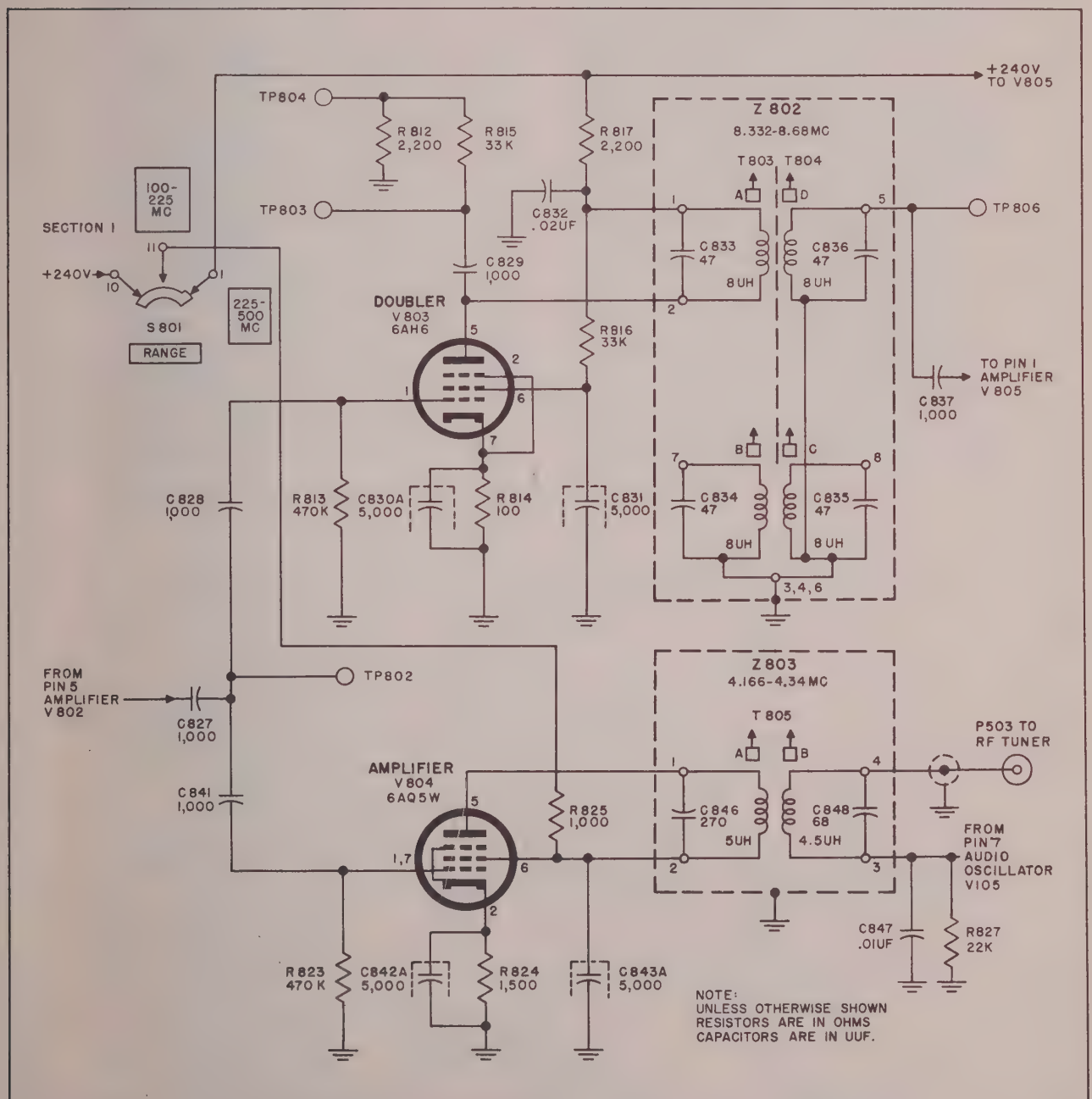


Figure 24. Frequency Meter LA-6, Doubler V803 and Amplifier V804 Band-Pass Circuit, Simplified Schematic

second. The secondary consists of inductance T804D and C836 in one tank circuit, and T804C and C835 in the other. The output signal of the network is coupled through C837 to the control grid of amplifier V805.

(2) Doubler V803 is cathode biased by R814 and C830A in parallel. The control grid return is provided by R813. Plate and screen voltage is supplied to V803 through RANGE switch S801, section 1. Resistor R817 and capacitor C832 provide decoupling; screen voltage is applied through dropping resistor R816 and the screen is bypassed by C831. Two test points are provided at the plate of V803. The output signal is coupled through C829 to TP803, and a second test output at a lower level is available at TP804, which is connected to the junction of the voltage divider consisting of R812 and R815.

c. Amplifier V804 (fig. 24).

(1) If the signal to be measured is in the 100- to 225-mc range, RANGE switch S801, section 1, removes plate power from doubler V803 and applies it to amplifier V804. This tube is a cathode-biased, single-ended beam-power amplifier with the plate tank circuit tuned to a flat response through 4.166- to 4.34-mc. The output of this tube is used to drive a crystal harmonic generator. A high-level input is necessary, therefore, to make effective use of the upper harmonics.

(2) The input signal is coupled through capacitors C827 and C841 to the control grid. The grid return is provided by resistor R823. The tuned plate load for the stage consists of T805A and C846 in the primary and T805B and C848 in the secondary. The output signal developed in the secondary is coupled through P503 to the rf tuner subchassis. When the frequency meter is being coarse-tuned, the audio signal from audio oscillator V105 is applied through the secondary circuit to the rf tuner.

(3) Cathode bias for V804 is provided by R824 and C842A. Plate and screen voltage are supplied through RANGE switch S801, section 1, and through decoupling network R825 and C843A.

d. Power Amplifier V805 (fig. 25).

(1) Beam-power amplifier V805 produces a strong signal for the crystal harmonic generator in the rf tuner so that relatively weak upper harmonics are strong enough to be used effectively. The input signal is coupled through C837 across R818 and applied to control grid of V805. The output signal is developed in the tuned plate load consisting of the primary of T806, C844, and loading resistor R821. The signal is inductively coupled to the secondary of T806 and applied through P504 to the rf tuner subchassis. Network Z804 is permeability tuned to pass unattenuated signals in the 8.322- to 8.68-mc range. The signal from audio oscillator V105 is also applied through the secondary to the rf tuner when the equipment is being coarse-tuned.

(2) Plate and screen voltage is supplied to V805

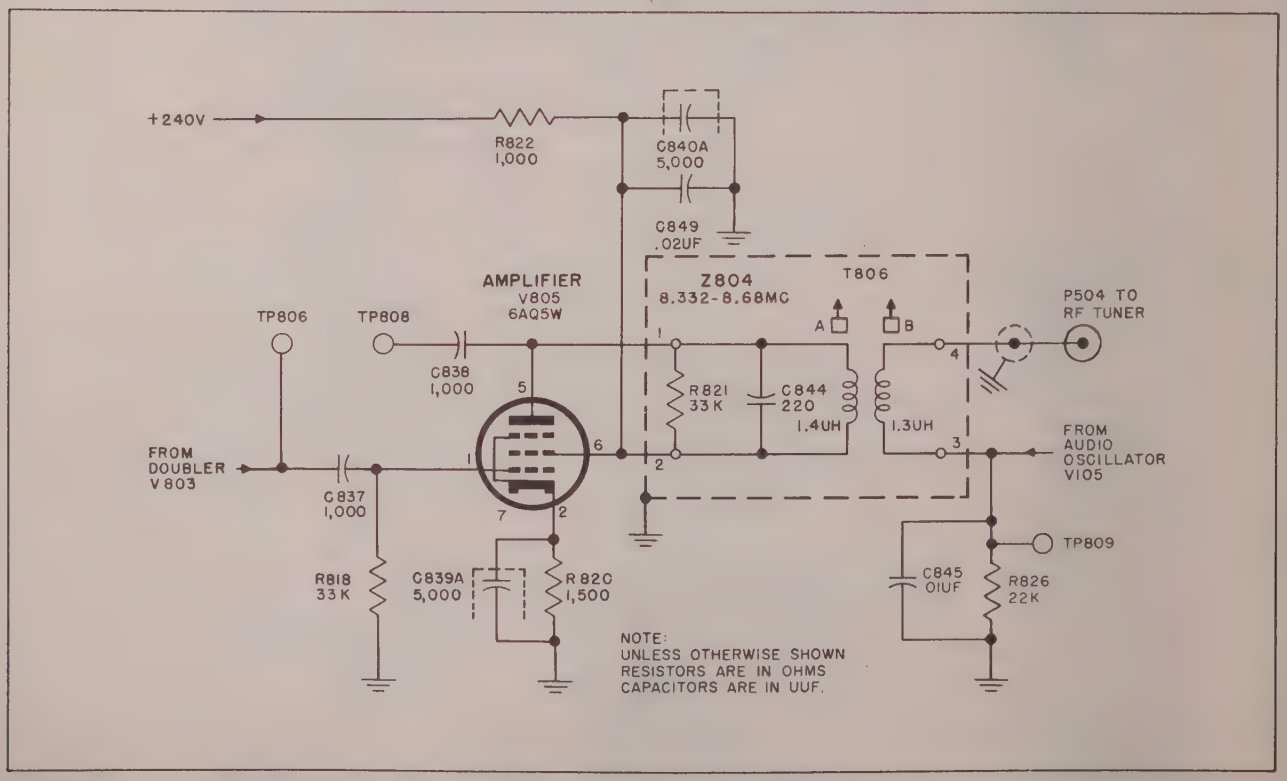


Figure 25. Frequency Meter LA-6, Power Amplifier V805, Band-Pass Circuit Simplified Schematic

through RANGE switch S801 when the FUNCTION SWITCH is in the 225-500 MC position. The voltage is applied through decoupling network R822 and capacitors C840A and C849. Test points are provided at three points in the circuit. Test point TP806 is at the input to the stage; TP808 is in the plate circuit, the plate signal being coupled through C838 to the test point; and TP809 is available for checking the audio note from the oscillator. The audio signal is developed across R826 and C845 in parallel.

36. Rf Tuner

The rf tuner contains a dual circuit arrangement; one half is used to cover the 100- to 225-mc range, and the other half covers the 225- to 500-mc range. The two sections are identical; therefore, only one section will be discussed.

a. The tuning network is a parallel-resonant circuit that consists of a two-conductor transmission line long enough to make its impedance inductive over the frequency range involved, and a precision capacitor that can be rotated to vary the resonant frequency of the combination. The schematic of the rf tuner is shown in figure 26A. Figure 26B shows the equivalent circuit as a double-ended parallel lc circuit and figure 26C shows the single ended equivalent. In figure 26C, crystal diode CR1 is tapped across a portion of the circuit and is connected to a source of audio-frequency signal as an rc biasing combination. The audio voltage across the diode produces an audio-frequency variation in its impedance, which is reflected into the tuned circuit to cause an audio-frequency variation in the amplitude of the unknown rf signal that appears across detector CR2. The detector removes the audio signal and passes it to the audio amplifier from which it is available for headphones and tuning meter. As the capacitor is tuned to a point where it forms a parallel-resonant circuit at the unknown frequency, an audio tone is heard in the headphones or shown on the TUNING METER.

b. Applying this to the actual circuit as shown in figure 26A, when the FUNCTION SWITCH is in the COARSE position, a 1,000-cycle audio note from V105 is applied to CR501. The unknown signal that is injected into the circuit through the probe is modulated by the audio noise. Crystal diode CR503 detects the audio signal, which is applied to the preamplifier through C505.

c. When the FUNCTION SWITCH is in the FINE position, the audio signal is removed from CR501 and replaced by the standard basic frequency output of the band-pass amplifier. Crystal diode CR501 now acts as a harmonic generator. As the interpolation oscillator frequency is varied, one harmonic will approach the frequency of the unknown signal. Both signals are coupled to detector crystal CR503 and mixed, producing a beat note. All other harmonics are shunted to ground because the resonant circuit is a low impedance to any frequency except that to which it is tuned. Thus, the rf tuner determines the approximate frequency and selects the proper harmonic for producing an audio beat note.

37. Preamplifier

a. Preamplifier V201 (fig. 27) is a double triode used to amplify the weak audio signal that results from

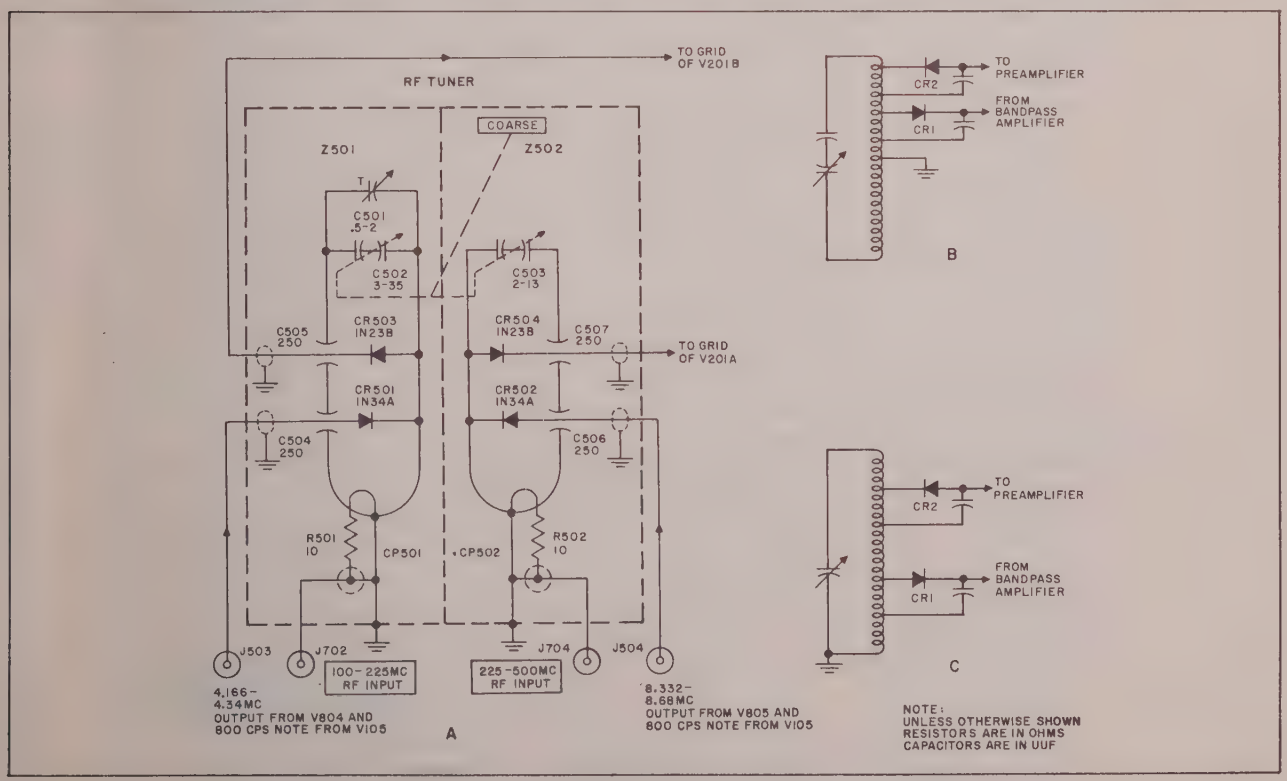


Figure 26. Frequency Meter LA-6, RF Tuner, Simplified Schematic

mixing the unknown frequency with an upper harmonic of the signal generated within the frequency meter. RANGE switch S801 applies plate power to section B or section A of preamplifier V201, depending on whether the signal under measurement is in the 100- to 225-mc band or the 225- to 500-mc band, respectively. This switch also applies 6.5 volts to the appropriate range indicator lamp. The audio signal to V201A is resistance-capacitance (rc) coupled to the control grid by resistor R209, capacitor C203, and resistor R201. Resistor R204 provides the cathode bias. The amplified signal taken off the plate is coupled through capacitor C202 to the audio amplifier. Resistor R202 is the plate decoupler, capacitor C204A is the bypass to ground, and resistor R203 is the plate load for this section of the tube.

b. The audio signal to V201B is rc coupled to the control grid by resistor R210, capacitor C205, and resistor R208. Resistor R205 provides the grid bias. In both sections of V201, the cathodes are unbypassed to produce degeneration for improved response. The amplified signal is coupled through capacitor C201 to the audio amplifier. Resistor R207 is the plate load. Capacitor C204 is a bypass to ground and resistor R206 is the plate decoupling and voltage dropper.

38. Check System

The check system consists of doubler V301, amplifier V303B, harmonic generator V302, and detector V303A. This system provides a means of ascertaining when the interpolation oscillator is operating at the calibrated frequency, as indicated by the check points along the film strip. To do this, harmonics of the interpolation oscillator are heterodyned with the crystal oscillator signal doubled to 8 mc. A simplified schematic of the check circuit is shown in figure 28.

a. When FUNCTION SWITCH S701 is in the CHECK position, plate voltage is applied to doubler V301 and amplifier V303B, energizing these circuits. Through jack J302, the 4-mc signal from the crystal oscillator is fed through capacitor C301 across grid return re-

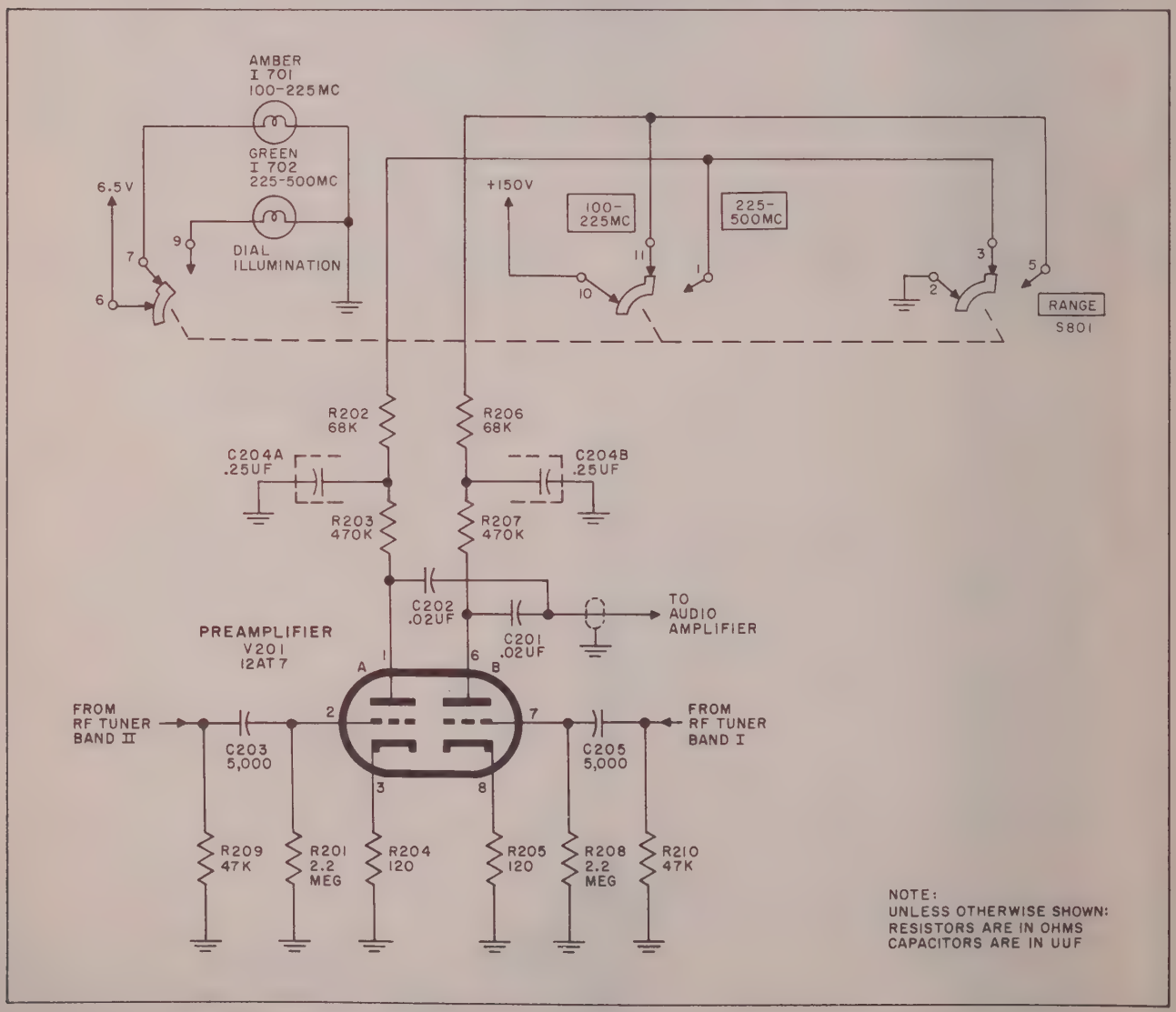


Figure 27. Frequency Meter LA-6, Preamplifier V201, Simplified Schematic

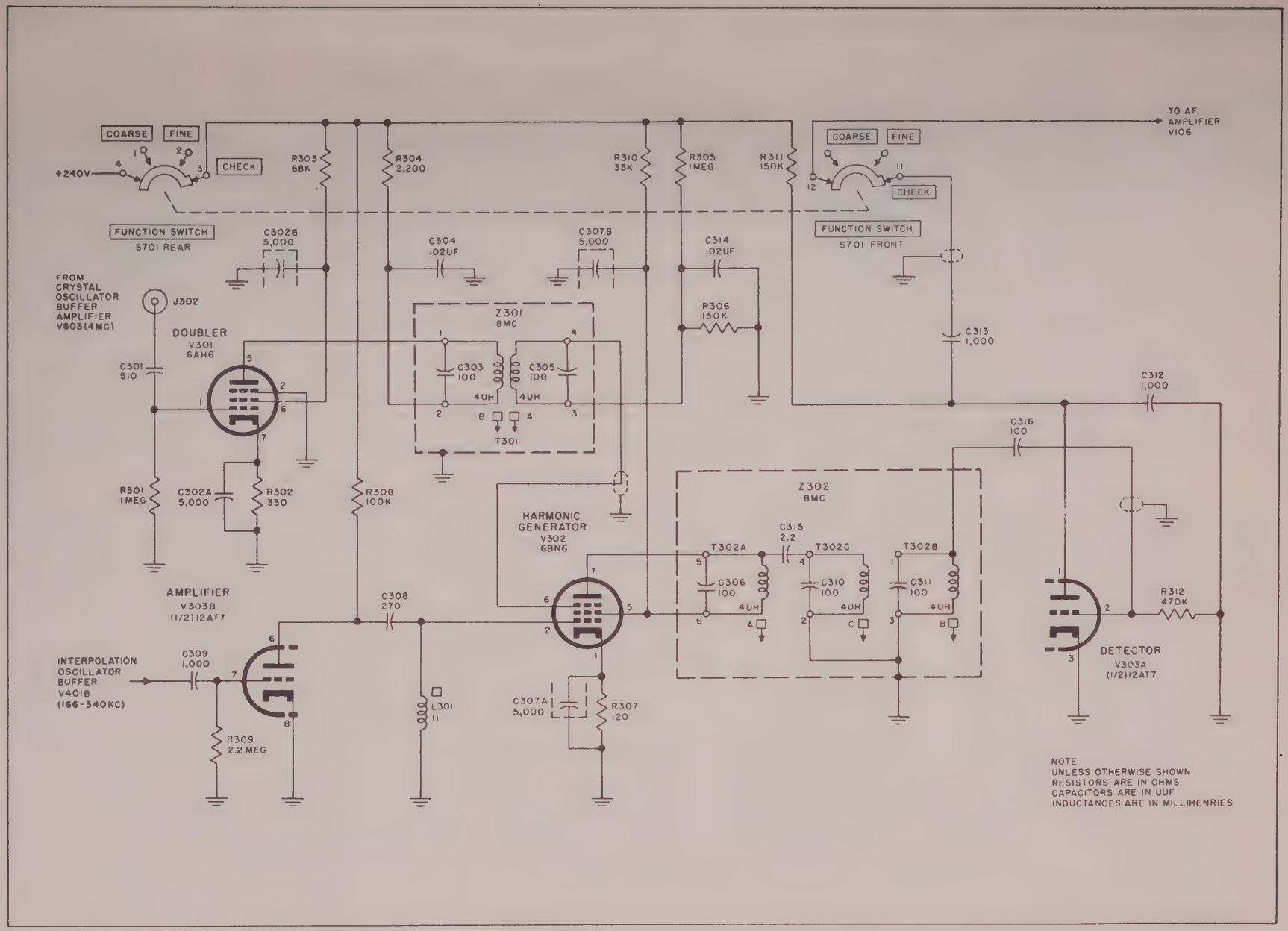


Figure 28. Frequency Meter LA-6, Check System Circuit, Simplified Schematic

sistor R301 to the control grid of doubler V301. Cathode bias is provided by resistor R302, bypassed by capacitor C302A. The plate tank circuit, consisting of the primary of transformer T301 in parallel with capacitor C303, is permeability tuned to the second harmonic of the 4-mc input signal. This 8-mc signal then is coupled across the secondary of transformer T301 to V302 (fig. 28). Resistor R304 and capacitor C304 provide plate decoupling; the screen voltage is dropped by resistor R303, bypassed by capacitor C302B.

b. Tube V303B amplifies the interpolation oscillator signal that is coupled through capacitor C309 and across grid return resistor R309 to the control grid. Resistor R308 is the plate load for the output signal, which is coupled through capacitor C308 to harmonic generator V302. Amplifier V303B operates as a grid-leak biased amplifier. Bias is developed in the grid circuit by C309 and R309.

c. The output of doubler V301 is coupled across the secondary of transformer T301, tuned to 8-mc by fixed capacitor C305 (fig. 28). This signal is then applied to the quadrature grid of electron-coupled harmonic generator V302. The operating potential of this grid is determined by voltage-divider resistors R305 and R306, bypassed by capacitor C314. Harmonic generator V302 will not conduct, however, until a positive signal is developed across rf choke L301 to overcome the cathode bias supplied by resistor R307, bypassed by capacitor C307A.

d. Gating the tube in this manner causes V302 to discriminate against all but the true interpolation oscillator signal. Weak spurious harmonic signals cannot develop sufficient positive voltages across L301 to overcome V302's cathode bias. Beating harmonics of spurious signals with the 8-mc signal is thus avoided and also false check points eliminated. A nonlinear signal, amplified in the triode section of the tube, generates the harmonics necessary to mix with the 8-mc signal on the quadrature grid. The plate and accelerator grid operate at the same dc potential as determined by resistor R310.

e. During the tuning process of the interpolation oscillator, harmonics will periodically enter the 8-mc range. When this occurs, the interpolation oscillator signal beats against the 8-mc signal, producing an audio difference frequency which modulates the 8-mc signal. This modulated signal is permeability tuned in triple stage network Z302, consisting of capacitor C306 across T302A, capacitor C310 across T302C, and capacitor C311 across T302B. Blocking capacitor C315 couples T302A and T302C.

f. The mixed signal is fed to the grid of detector V303A. The coupling network consists of C316 and R312. A high negative charge builds up in C316, which keeps the tube at cutoff during the negative portion of the signal. Rectification takes place and only half of the modulation envelope appears across plate load resistor R311; C312 bypasses the rf component of the signal to ground while the audio component is applied to the amplifier through capacitor C313.

g. As the interpolation oscillator harmonic approaches 8-mc, a note of ever decreasing frequency is heard at the headphones, disappearing at zero beat. The meter reading also diminishes to zero. When this occurs, the hairline across the film strip dial window should be superimposed on a check point.

39. Audio Amplifier and Meter Output Circuit

The audio amplifier amplifies audio signals that result from the heterodyning of the unknown frequency with harmonics of the frequency developed by the frequency meter. It consists of af amplifier V106, meter output amplifier V108, gated af amplifier V107, and af output amplifier V108. The simplified schematic of the audio amplifier is shown in figure 29.

a. When FUNCTION SWITCH S701 is in CHECK position, the front segment conducts the check system signal across grid return resistor R108 to the control grid of audio-frequency (af) amplifier V106. The rear segment of FUNCTION SWITCH S701 simultaneously connects resistor R704 to resistor R107 to form the cathode bias.

b. When FUNCTION SWITCH S701 is in FINE or COARSE position, the output signal from preamplifier V201 is taken from potentiometer R701A or R701B, respectively, and fed across grid return resistor R108 to the control grid of V106. Potentiometer R701 is the LEVEL control to determine the input signal strength to V106. Resistor R705 is used in a voltage-divider network with potentiometer R701A. Resistor R706 is used in a voltage-divider network with potentiometer R701B.

c. In the FINE or COARSE position, FUNCTION SWITCH S701 connects RT701 to resistor R107 to provide the optimum cathode bias for V106. Capacitor C106A is the cathode bypass.

d. The signal applied at the control grid is amplified within the tube and divider at the output. Resistor R110 is the plate decoupler and resistor R112 the plate load. Resistor R111, forming a voltage divider with resistor R107, provides a fixed source of cathode bias and improves operating stability. Capacitors C106B and C107 are bypasses to ground. One output signal from V106 is coupled through capacitor C109 to the grid of af amplifier V107. The other output signal is fed through capacitor C108 to the control grid of meter output amplifier V108A. Resistor R121 is the grid return for this tube, while resistor R123 furnishes the cathode bias. Resistor R119 is the plate load.

e. The amplified output from V108A is fed through capacitor C116 and variable resistor R703 to TUNING METER M701 and through C110 to crystal detector CR 101. Within the meter full-wave rectification of the signal takes place in a crystal bridge arrangement. The resulting pulsating dc signal is then used to actuate the dc milliammeter. Variable resistor R703 determines the amount of needle deflection.

f. The signal, coupled through capacitor C110, is rectified by crystal detector CR101 and fed through resistor R114 to the control grid of af amplifier V107. Resistor R113 protects the crystal while providing the grid return for V107. Capacitor C111 is a bypass to ground.

g. Audio-frequency amplifier V107 is a gated tube that remains cut off to all spurious signals and operates as follows: the signal from V106 is coupled through capacitor C109 to the grid of af amplifier V107. The tube does not conduct, however, because of the cutoff bias established by variable resistor R116 in series with resistor R109. The tube remains cut off until a signal from V108A, rectified by crystal CR101, is of sufficient amplitude to drive the control grid positive with respect to the cathode. Because the tuned signal

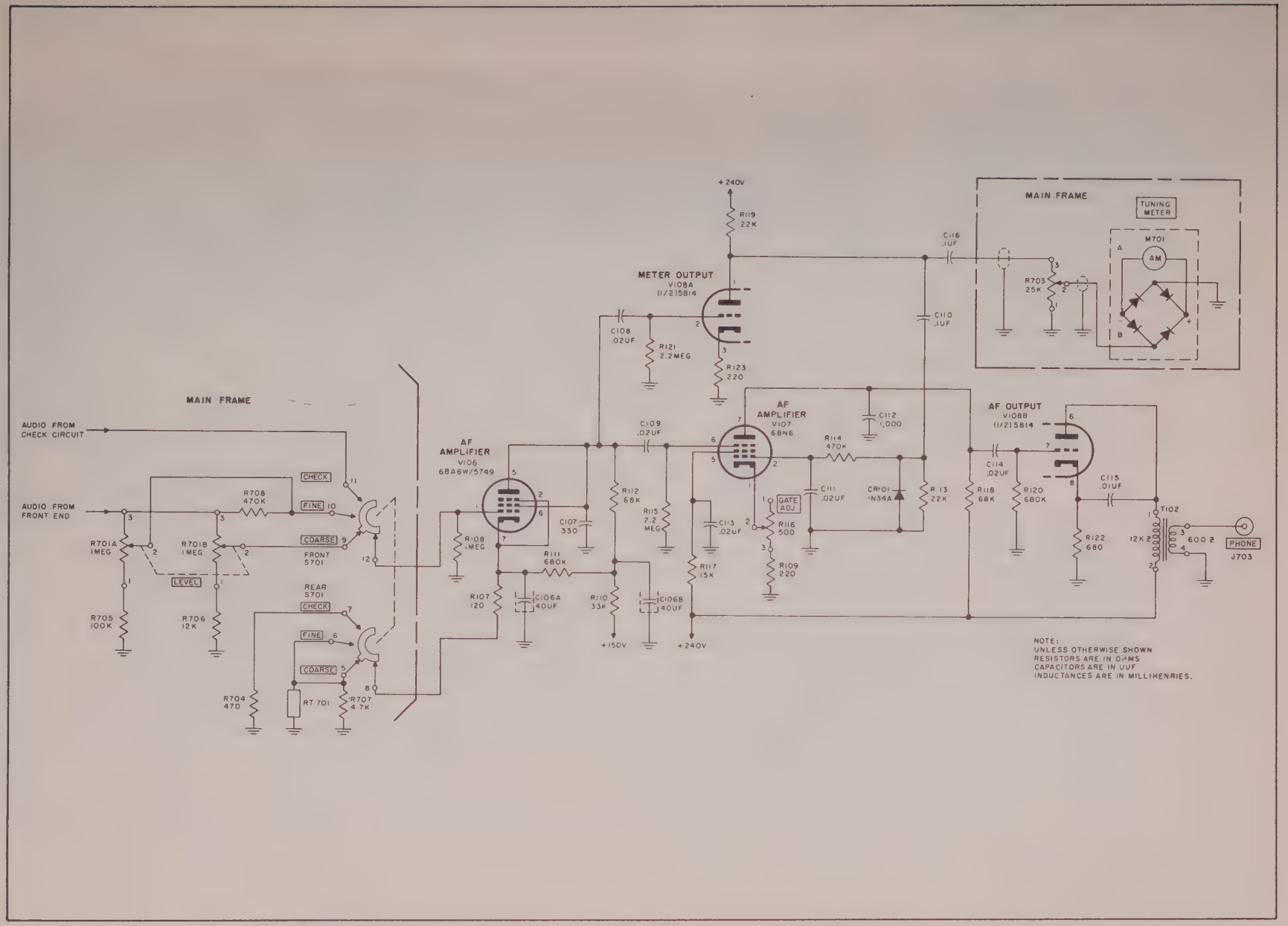


Figure 29. Frequency Meter LA-6, Audio-Amplifier Circuit, Simplified Schematic

strength exceeds that of spurious signals, GATE ADJ. control R116 can gate the operation of V107 to discriminate against all but the desired signal. Resistor R118 is the plate load and capacitor C112 provides a low-reactance path to ground for any high-frequency signals amplified by V107. The screen grid potential is determined by resistor R117, bypassed by capacitor C113.

h. The output of V107 is coupled through capacitor C114 and across grid return resistor R120 to the control grid of af output amplifier V108B. The inductance of the primary of T102, and C115 in series with R122 forms a parallel-resonant circuit that places the peak of the frequency response at about 300 cycles per second. Matching transformer T102 couples the output from V108B to PHONE jack J703 on the front panel.

40. Audio Oscillator

a. Audio oscillator V105 (fig. 30) is an electron-coupled, self-driven relaxation-type oscillator that supplies an 800 ± 300-cps audio note to modulate the unknown signal during the coarse tuning process. The frequency of oscillation is determined by the time constant of the rc network made up of grid return resistor R105 and capacitor C105. If tube V105 is conducting heavily because of the positive control grid bias and high positive voltage on the accelerator grid, the resulting plate voltage drop, is felt across accelerator grid-dropping resistor R106. Capacitor C105 can no longer hold its high charge and begins to discharge through resistor R105 at a rate determined by the values of each.

b. A negative-going signal is felt at the control grid, reducing the conduction within the tube. At cutoff, plate voltage rises and is felt on the positive plate of capacitor C105, which begins charging again through resistor R105. A positive-going signal is felt at the control grid and the tube begins conducting heavily again, repeating this cycle at an audio rate. The audio-output signal is taken from plate load resistor R104 and coupled through capacitor C103. Capacitor C104 is a bypass to ground. The signal is applied through C103 and the low-pass filter, consisting of L802 and C807, and through C811 to S801. Depending upon the position of RANGE switch S801, the audio note is fed to the rf tuner either through the secondary of coupling transformer T804 or T805.

41. Power Supply

POWER switch S702 applies line voltage to the primaries of power transformer T101 (fig. 31). Switch S101 connects the primaries in parallel when operating the equipment from a 110-volt ac source, and in series for operation from a 220-volt ac source. Heater current for crystal oven E601 is taken across terminals 1

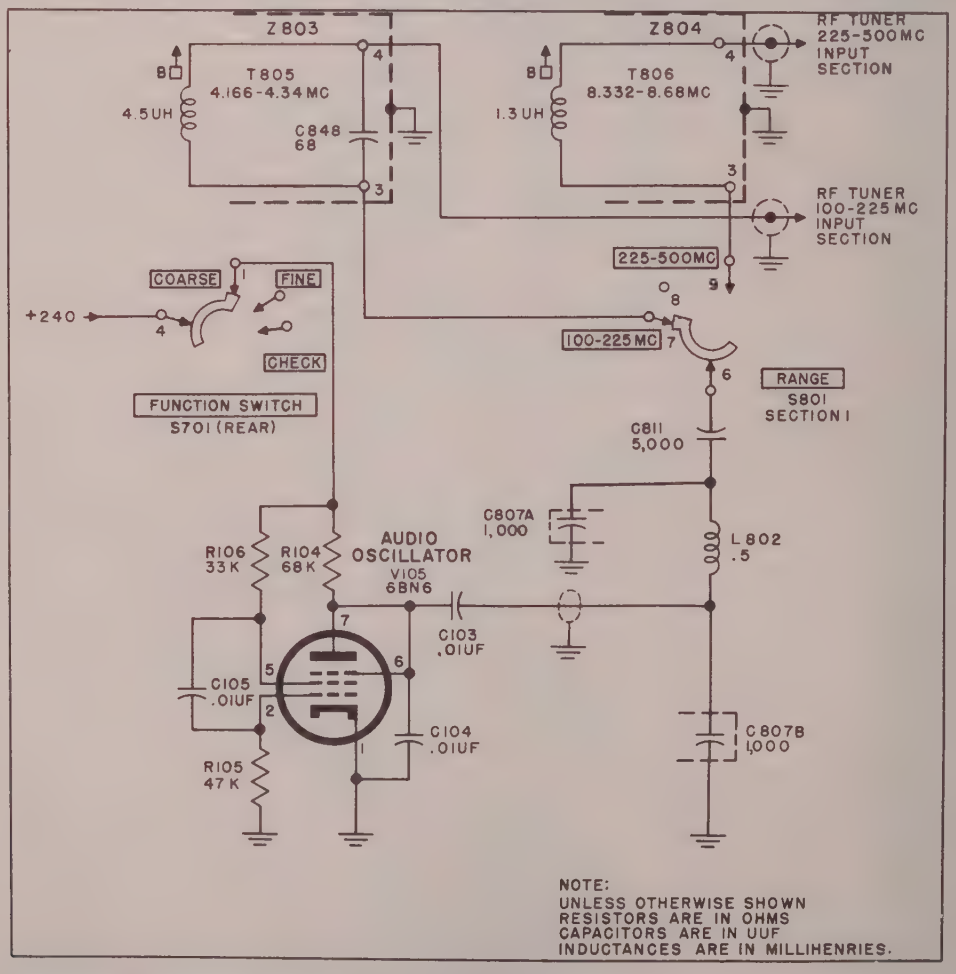


Figure 30. Frequency Meter LA-6, Audio Oscillator V105, Simplified Schematic

and 4 of the transformer T101 primary. Both sides of the input power line are fused by 1.5 ampere fuses F701 and F702.

a. Filament Supplies. The 6.4-volt ac filament supply for tubes V101, V102, V105, V106, V107, V108 is taken from terminals 11 and 13 of transformer T101 secondary. All other tube filaments and illumination lamps are supplied by 6.5-volt terminals 8 and 10 of the transformer T101 secondary.

b. Positive 240-volt Dc Supply. Secondary terminals 5 and 7 supply plate power to two full-wave rectifiers, V101 and V102, connected in parallel for greater current output. The positive pulsating dc taken at the cathodes is smoothed out by a two-section choke input filter composed of choke coils L101 and L102 and filter capacitors C101 and C102. Resistor R103 discharges capacitors C101 and C102 when the equipment is shut down.

c. Regulated Supplies. Voltage regulator V103 stabilizes the voltage taken from series-dropping resistor R101 at positive 150 volts dc. Voltage regulator V104 stabilizes the voltage taken from series resistor R102 at positive 108 volts dc.

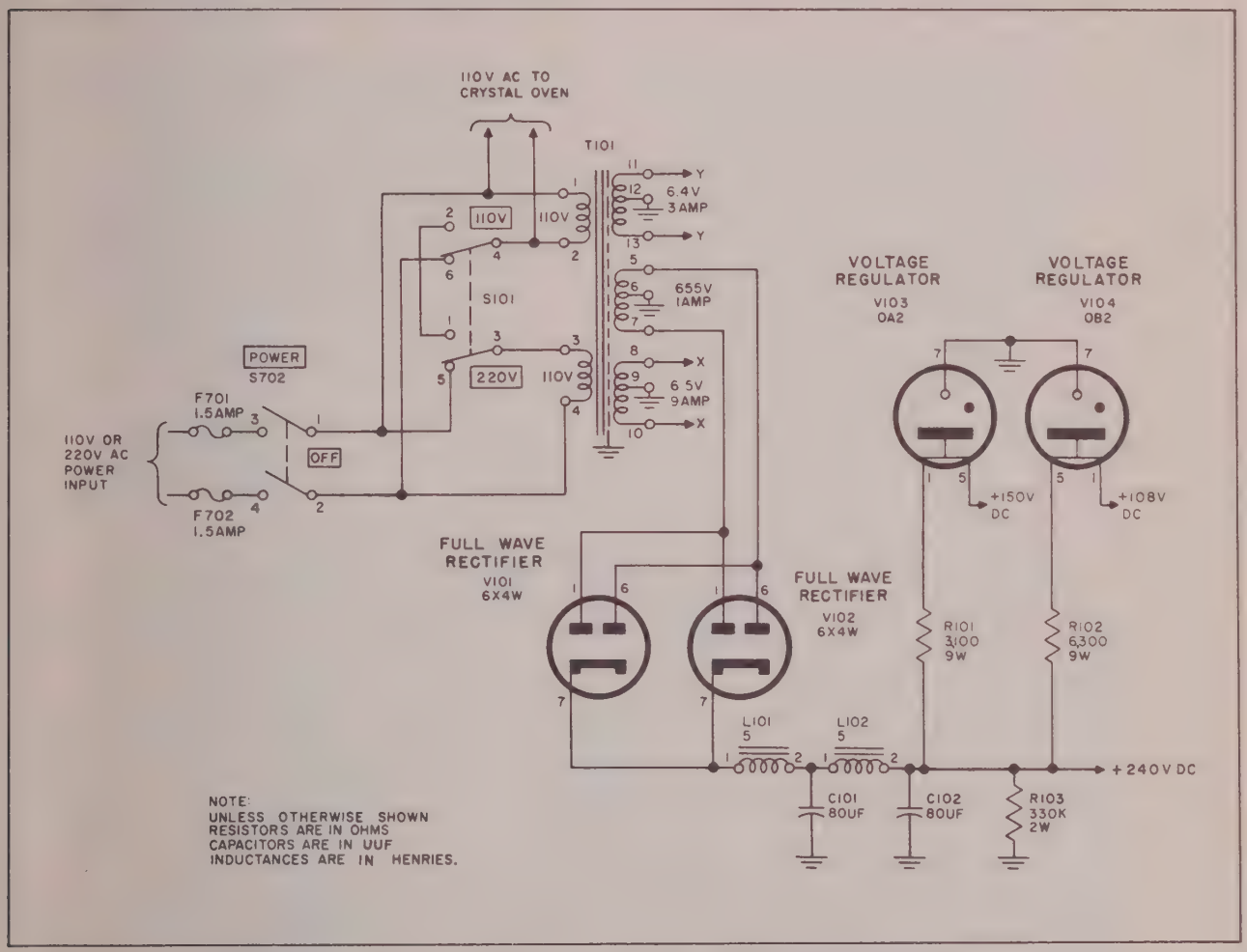


Figure 31. Frequency Meter LA-6, Power Supply, Simplified Schematic

CHAPTER 5

FIELD MAINTENANCE

Note. This chapter contains information for field maintenance. The amount of repair that can be performed is limited only by the tools and test equipment available and by the skill of the repairman.

Section I. TROUBLE SHOOTING AT FIELD MAINTENANCE LEVEL

42. Trouble-shooting Procedures

a. General. The first step in servicing a defective frequency meter is to sectionalize the fault. Sectionalization means tracing the fault to the major component or circuit responsible for the abnormal operation of the frequency meter. The second step is to localize the fault. Localization means tracing the fault to the defective part responsible for the abnormal condition. Some faults, such as burned-out resistors and shorted transformers, often can be located by sight, smell, and hearing. The majority of faults, however, must be localized by checking voltages and resistances.

b. Component Sectionalization and Localization. Listed below is a group of tests arranged to simplify and reduce work, as well as aid in tracing a trouble to a particular component. The simple tests are used first, followed by those more complex. Follow the procedure in the sequence given. Be careful to avoid further damage to the frequency meter while servicing. In general, the trouble is traced to a section of the frequency meter; the faulty component of that section is located; then the trouble is remedied. The service procedure is summarized as follows:

(1) Visual inspection. The purpose of visual inspection is to locate any visible trouble. Through inspection alone the repairman may frequently discover the trouble or determine the circuit in which the trouble exists. This inspection is valuable in avoiding additional damage to the frequency meter which might occur through improper servicing methods, and in forestalling future failures.

(2) Input resistance measurements. These measurements prevent further damage to the frequency meter from possible short circuits. Since this test gives an indication of the condition of the filter circuits, its function is more than preventive.

(3) Operational test. The operational test is important because it frequently indicates the general location of the trouble. In many instances the information gained will determine the exact nature of the fault. To use this information fully, all symptoms must be interpreted in relation to one another.

(4) Trouble-shooting chart. The trouble symptoms listed in this chart will aid greatly in localizing trouble.

(5) Signal substitution. Signal substitution generally is not used for trouble shooting a frequency meter. However, if the proper signal sources are available, it is possible to use signal substitution to advantage.

(6) Chassis substitution. It is possible to replace any of the easily detached subassemblies with a similar one known to be in operating condition.

(7) Intermittents. In all these tests, the possibility of intermittents should not be overlooked. If present, this type of trouble may be located by jarring the equipment or by tapping tubes and other parts. It is possible that an external connection may be causing the trouble. Test wiring and soldered connections with an insulated rod. This may locate a faulty connection or component.

43. Trouble-shooting Data

CAUTION: Always check the circuit label, because the schematic diagram in this manual may not include circuit changes made during equipment production. Take advantage of the material supplied in this manual. It will help to locate faults rapidly. Consult the following trouble-shooting data:

Fig. No.	Description
32	Frequency Meter LA-6, top view of chassis.
33	Frequency Meter LA-6, rear view with chassis removed, location of parts.
34	Frequency Meter LA-6, right side view, location of parts.
35	Frequency Meter LA-6, left side view, location of parts.
36	Frequency Meter LA-6, power supply chassis, bottom view, location of parts.
37	Frequency Meter LA-6, crystal oscillator, balanced-modulator chassis, bottom view, location of parts.
38	Frequency Meter LA-6, band-pass amplifier chassis, bottom view, location of parts.
39	Frequency Meter LA-6, interpolation oscillator chassis, bottom view, location of parts.
40	Frequency Meter LA-6, preamplifier chassis, bottom view, location of parts.

Fig. No.	Description
41	Frequency Meter LA-6, check system chassis, bottom view, location of parts.
42	Frequency Meter LA-6, film mechanism assembly, exploded view.
43	Frequency Meter LA-6, rf tuner and drive assembly, exploded view.
46	Frequency Meter LA-6, tube socket voltage and resistance diagram, CHECK position.
47	Frequency Meter LA-6, tube socket voltage and resistance diagram, COARSE position.
48	Frequency Meter LA-6, tube socket voltage and resistance diagram, FINE position.
49	Frequency Meter LA-6, schematic diagram.
50	Frequency Meter LA-6, main frame wiring and interconnection diagram.

Fig. No.	Description
51	Frequency Meter LA-6, power supply, audio oscillator, and audio amplifier chassis, wiring diagram.
52	Frequency Meter LA-6, crystal oscillator-balanced modulator chassis, wiring diagram.
53	Frequency Meter LA-6, band-pass amplifier chassis, wiring diagram.
54	Frequency Meter LA-6, interpolation oscillator chassis, wiring diagram.
55	Frequency Meter LA-6, check system chassis, wiring diagram.
56	Frequency Meter LA-6, preamplifier chassis, wiring diagram.

44. Test Equipment Required for Trouble Shooting

Test equipment required for trouble shooting Frequency Meter LA-6 are the same as those used for alignment. Refer to paragraph 61.

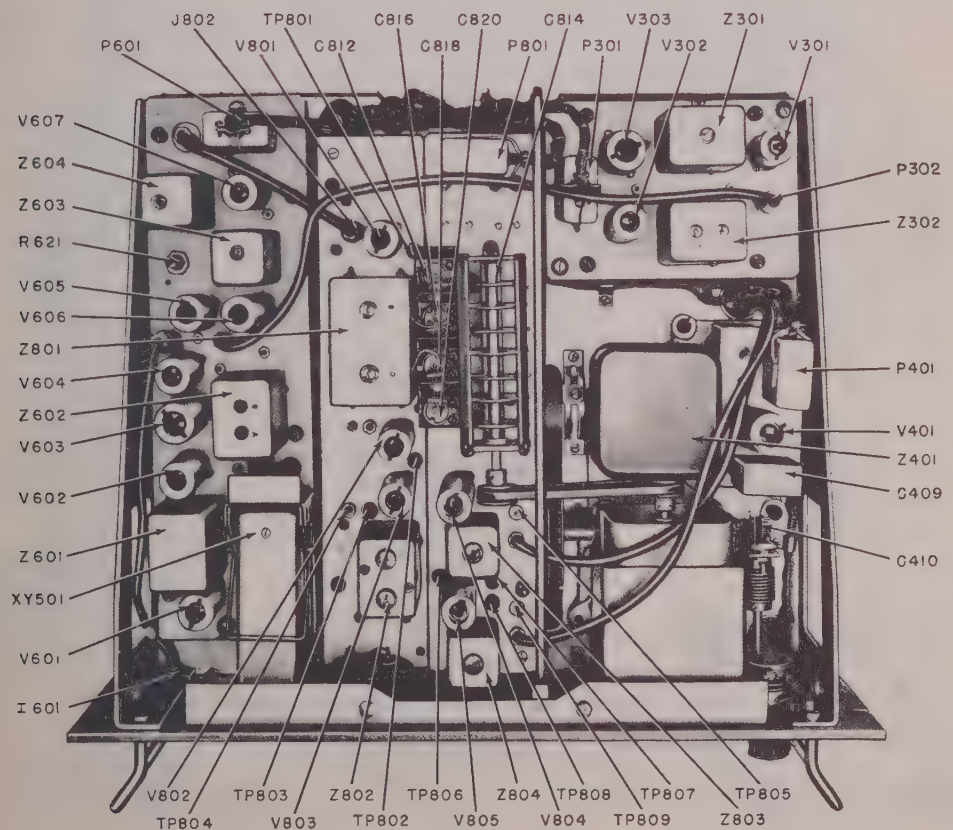


Figure 32. Frequency Meter LA-6, Top View, Location of Parts

45. General Precautions.

NOTE: To remove a subchassis, disengage electrical connections and the retaining screws. These screws are painted black. To remove the subchassis base plates, remove the unpainted screws mounted on black seats. Observe the following precautions carefully whenever servicing the frequency meter.

a. Be careful of dangerous voltages when the frequency meter is removed from the dust cover.

b. If the frequency meter has been operating for some time, use a cloth when removing the metal tube shields, and a tube puller to remove the tubes to prevent burning the hands or fingers.

c. Be careful not to bend any capacitor plates during servicing. When service is completed, engage all tuning capacitors and examine for contact between the plates.

d. Avoid excessive strain on all screws when tightening.

e. When changing a component that is held by screws, always replace the lock washers.

f. Careless replacement of parts often leads to new faults. Note the following points:

(1) Before a part is unsoldered, observe the position of the leads. If the part has a number of connections, tag each lead.

(2) Be careful not to damage other leads by pushing or pulling them out of the way.

(3) Do not use a high wattage soldering iron when soldering small resistors or capacitors. Overheating the small parts may ruin them or change their electrical values.

(4) When resoldering, check leads against wiring diagrams.

(5) Use resin core solder throughout.

(6) Do not allow drops of solder to drop into the chassis as they may cause shorts.

(7) Avoid using too much solder, especially at tube sockets because flowing resin may cause poor connection between tube pin and socket.

(8) Avoid high resistance connection; be sure the soldering iron is hot.

(9) When a part is replaced in a high-frequency circuit, it must be placed in the same position occupied by the original part. A part which has the same electrical value but different physical size may cause trouble in high-frequency circuits. Be careful of prop-

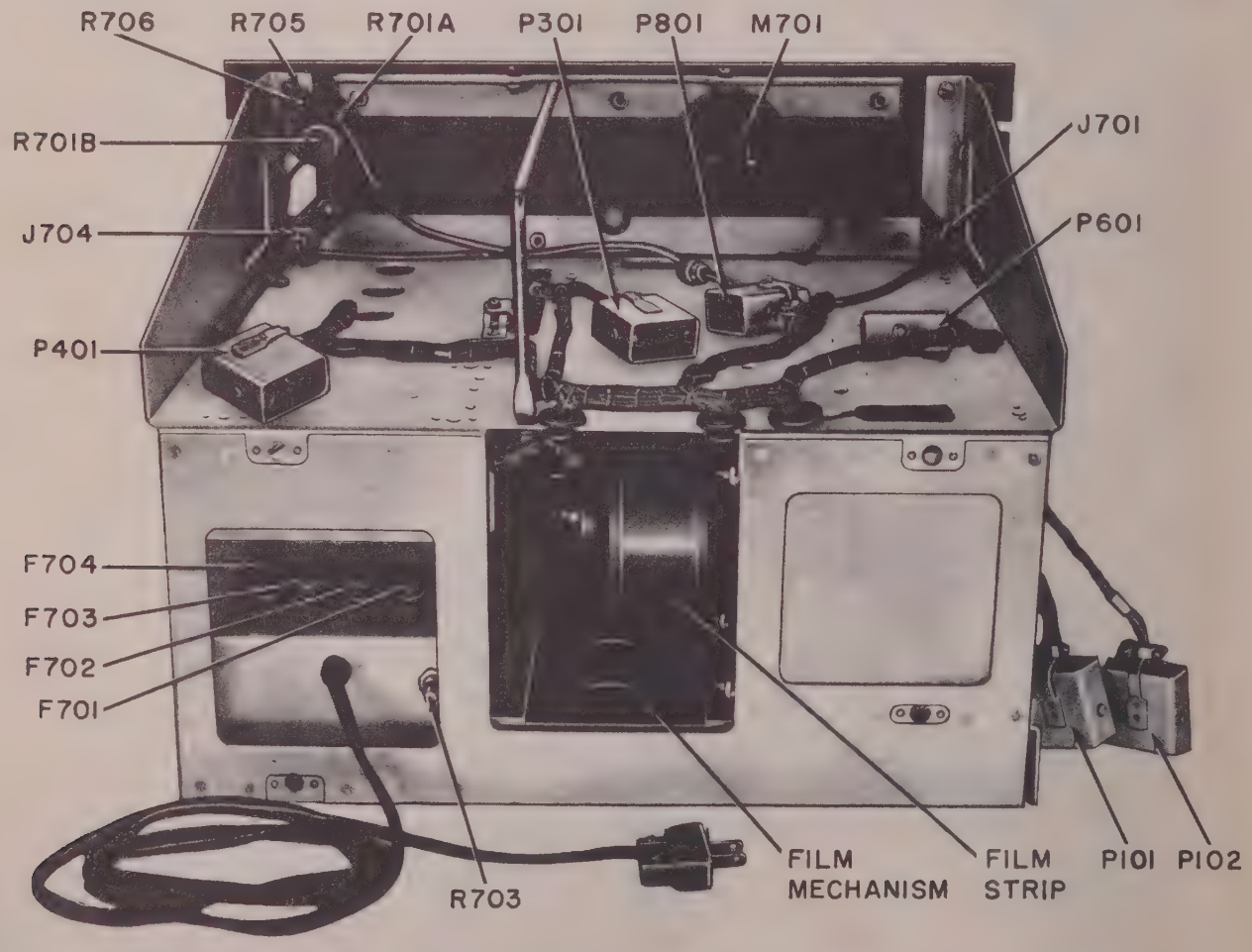


Figure 33. Frequency Meter LA-6, Rear View, with Chassis Removed, Location of Parts

er grounding; use the same grounding post as used in the original wiring.

(10) Twist all filament leads. Lay all wires flat against the chassis to avoid effects of stray coupling.

(11) Avoid sharp bends in coaxial cables that may cause inner conductors to penetrate the dielectric and make contact with outer conductor.

(12) Observe polarities when replacing (electrolytic) capacitors.

(13) Do not force tubes into sockets. If difficulty is encountered, check alignment of pins.

(14) Do not distrub any of the alignment adjustments unless it has been determined that the trouble is caused by a particular adjustment.

46. Subassembly Substitution

If the tactical situation is such that extra frequency meters are available, it is possible to substitute a subassembly from a unit known to be operating with one from a defective unit until the defective chassis is found. To remove subassemblies, follow instructions in section II, repairs.

47. Checking Filament and Plate Supply (B+) Circuits for Shorts.

a. From the filter sections in the power supply subassembly, the plate supply voltages are distributed to the various subchassis of the equipment. If the B+ voltage readings at the filter are low, the trouble may be within the power supply circuit, or the line voltage may be low. Check the line voltage under load. If it is within the proper limits, the trouble is caused by either a faulty rectifier tube, a faulty voltage regulator tube, a shorted filter capacitor, or an open filter choke. When checking the filter capacitors the test meter needle may show a direct short returning to infinity as the electrolyte in the filter capacitor ionizes. This is a normal condition. If the defect causing an abnormal B+ voltage is in some other circuit it can probably be localized by removing the power plug from each subassembly in turn. The B+ voltage should return to its proper value when the plug on the defective subassembly is disconnected. Refer to the over-all schematic diagram (fig. 49) and the voltage and resistance measurements (fig. 46, 47, and 48).

b. A trouble in any circuit will be noticed when following the operating procedures in chapter 2, section III. These troubles will be indicated in the equipment performance check list. Normally, using this procedure will narrow down the location to a section of the frequency meter or to one particular stage. Sometimes if the decoupling network of the B+ circuit is shorted, it may drop the voltage so that several stages are affected.

48. Trouble-shooting Chart

The chart is supplied as an aid in locating troubles in the frequency meter. It lists the symptoms which the repairman observes, either visually or aduibly, while making a few simple tests. The chart also indicates how to localize quickly the trouble to a subchassis. After the trouble has been localized to a stage or circuit, a tube check and voltage and resistance measurements of this stage or circuit ordinarily should be sufficient to isolate the defective parts. Normal voltage and resistance readings are shown in figures 46, 47, and 48.

48. Trouble-shooting Chart

Symptom	Probable Trouble	Correction
1. No film light when POWER switch is turned on.	1. Defective lamp I 703 or I 704.	1. Replace lamp.
2. No range dial light when POWER switch is turned on.	2. Defective lamp I 701 or I 702.	2. Replace defective lamp.
3. Frequency meter inoperative.	3. Fuse F701 or F702 blown.	3. See item 4.
	Line failure.	Check line voltage.
	Switch S702 failure.	Check voltages across all poles.
	Switch S101 failure.	Check voltage across transformer T101 primary.
	Defective rectifier tubes V101, V102.	Replace tubes.
4. Blown fuses F701, F702.	4. Shorted filter capacitors.	4. Replace capacitors C101, C102.
	Short in filament circuits.	Check T101 secondary voltage across terminals 8-10, 11-13. If reading is abnormal, check winding, then individual filament circuits for fault.

48. Trouble-shooting Chart (cont)

Sympton	Probable Trouble	Correction
4. Blown fuses F701, F702 (cont)	Short in B+ circuits.	Check T101 secondary voltage at terminals 5 and 7. If abnormal, check B+ circuits and filter capacitors C101, C102.
5. Low +240-volt dc circuit voltages.	5. Defective tube V101 or V102.	5. Replace defective tube.
	Defective filter capacitor C101 or C102.	Replace defective capacitor.
6. Low 150-volt circuit voltages.	6. Tube V103 defective.	6. Replace tube.
	Low supply voltage.	See item 5.
7. Low 108-volt circuit voltages.	7. Tube V104 defective.	7. Replace tube.
8. No audio tone at output during COARSE tuning, although tone is present when S701 is in FINE or CHECK position.	8. Audio oscillator tube V105 defective.	8. Replace tube.
9. No audio tone at output when switch S701 is in FINE position although tone is present during COARSE tuning.	9. Defective interpolation oscillator V401.	9. Replace tube.
	Defective crystal oscillator circuit.	Replace defective tube (V601, V602, or V603).
10. No audio tone at output during FINE tuning, although present when S701 is in CHECK position.	10. Defective balanced-modulator or band-pass amplifier circuit.	10. Replace tubes in these circuits with tubes known to be in good condition.
		Refer to items 15, 16, and 17.
11. No audio tone at the output when switch S701 is in CHECK position, although present when in COARSE or FINE position	11. Check system circuit defective.	11. Replace tubes in check system circuit with tubes known to be in good condition.
		Refer to item 18.
12. During COARSE tuning, audio note is heard at output on one range band only.	12. Defective rf tuner.	12. Replace either crystals CR501, CR504, or crystals CR502, CR503, depending on which are defective.
13. No audio tone at the output in any operation position of FUNCTION SWITCH and RANGE switch.	13. Preamplifier V201 or audio-amplifier circuits defective.	13. Replace tubes in these circuits with tubes known to be in good condition.
		Refer to item 17.
14. Crystal oscillator frequency erratic or output low.	14. Aging of crystal or oven heater burned out.	14. Replace crystal or oven unit.
15. Balanced-modulator output is low.	15. Input or output signals out of alignment.	15. Check and align as outlined in paragraph 63.

48. Trouble-shooting Chart (cont)

Symptom	Probable Trouble	Correction
16. Band-pass amplifier output is low.	16. Defective tube in circuit.	16. Replace tube.
	Band-pass amplifier out of alignment.	Check and align as outlined in paragraph 65.
17. Audio-amplifier circuit output is low.	17. Defective tubes (V106, V107, V108) in circuit.	17. Replace tubes.
	Defective crystal CR101.	Replace crystal.
	Tube V107 overbiased.	Readjust potentiometer R116.
18. Noise or hum present at output.	18. Tube V107 underbiased.	18. Readjust potentiometer R116.

49. Reference Symbol Numbers

The following chart lists the reference symbol number series for the various subassemblies.

Reference symbol number series	Subassembly
100	Power supply
200	Preamplifier
300	Check system
400	Interpolation oscillator
500	Rf tuner
600	Crystal oscillator-balanced modulator
700	Main frame
800	Band-pass amplifier

50. Dc Resistance of Transformers and Coils

The dc resistance of the transformers and coils in Frequency Meter LA-6 are listed in the following chart.

Reference symbol designation	Dc resistance
L602, L603, L801, L802	20
L402	50
L601	.8
L401	28.4
T301	.31, .31
T302C	.31
T302 A & B	.31, .31
T601	1.1, .8, .8
T602	1.0
T602	.5, .5
T603 & T604	.25, .15
T801 & T802	.5, .5
T803 & T804	.35, .35
T805	.3, .3
T806	1., .1
L803	3.2
L301	23

Section II. REPAIRS

51. Replacement of Parts

a. Most of the components of Frequency Meter LA-6 can be reached and replaced easily if found to be faulty.

b. If any of the switch wafers require replacement, carefully mark the wires connected to the wafer with tags to avoid misconnection when the new switch is installed. Follow this practice wherever replacement requires the disconnection of numerous wires.

c. To remove any subchassis cover, first remove the subchassis as outlined below then remove the screws with the black ring. Be careful when replacing all cables and connectors to avoid excessive binding.

52. Removal and Replacement of Film Mechanism

CAUTION: Be careful when removing and replacing the film mechanism to prevent damage to the film strip by a projection from the main frame.

a. To remove the film mechanism, proceed as follows:

(1) Remove the FINE tuning knob with an Allen wrench.
(2) Remove the drive belt from the interpolation oscillator large gear wheel.
(3) Withdraw the calibration tables drawer.

(4) Remove the four retaining screws located on the bottom of the main frame that hold the film mechanism.
(5) Pull out the film mechanism through the rear of the main frame.

b. To replace the film mechanism within the main frame, proceed as follows:

(1) Turn the film strip by hand to its low end so that 01-4166000 appears in the slot.
(2) Turn the COARSE control fully counter-clockwise (lowest numbers on band dial).
(3) Replace the film mechanism in the main frame and tighten the four retaining screws.
(4) Replace and tighten the FINE tuning knob.

CAUTION: Do not touch capacitor C410. It is factory-adjusted and is extremely critical. Any movement of this capacitor will void the entire calibration of the equipment.

(5) Put capacitor C402 at half mesh by using the CHECK control.
(6) Put tuning capacitor C403 to full mesh by using the large gear wheel on the side of the interpolation oscillator.
(7) Put C814 to full mesh by turning the gear wheel on the shaft of capacitor C814 on the band-pass amplifier.
(8) Hook up the rubber drive belts; be careful to maintain the capacitor settings of the previous steps.
(9) Turn the FUNCTION SWITCH to the CHECK position.
(10) Turn the FINE control to the low end until a zero beat is obtained on the TUNING METER. This should occur at the first check point on the film strip. If it occurs only slightly off this point, proceed as instructed in subparagraph (11) below. If it occurs more than two readings away from the check point, proceed as instructed in subparagraph (12) below.
(11) Center the check point in the window and adjust the CHECK control so that the zero beat is heard again. Proceed as instructed in subparagraph (13) below.
(12) Remove the rubber drive belt from the film mechanism and turn the film shaft so that the check point is centered in the window; then replace the drive belt. If the zero beat does not now occur exactly at the check point, proceed as instructed in subparagraph (10) above.
(13) Turn the FINE control clockwise and calibrate the film strip at each of the four succeeding check points as in step 11, above. The film mechanism is now replaced and realigned.

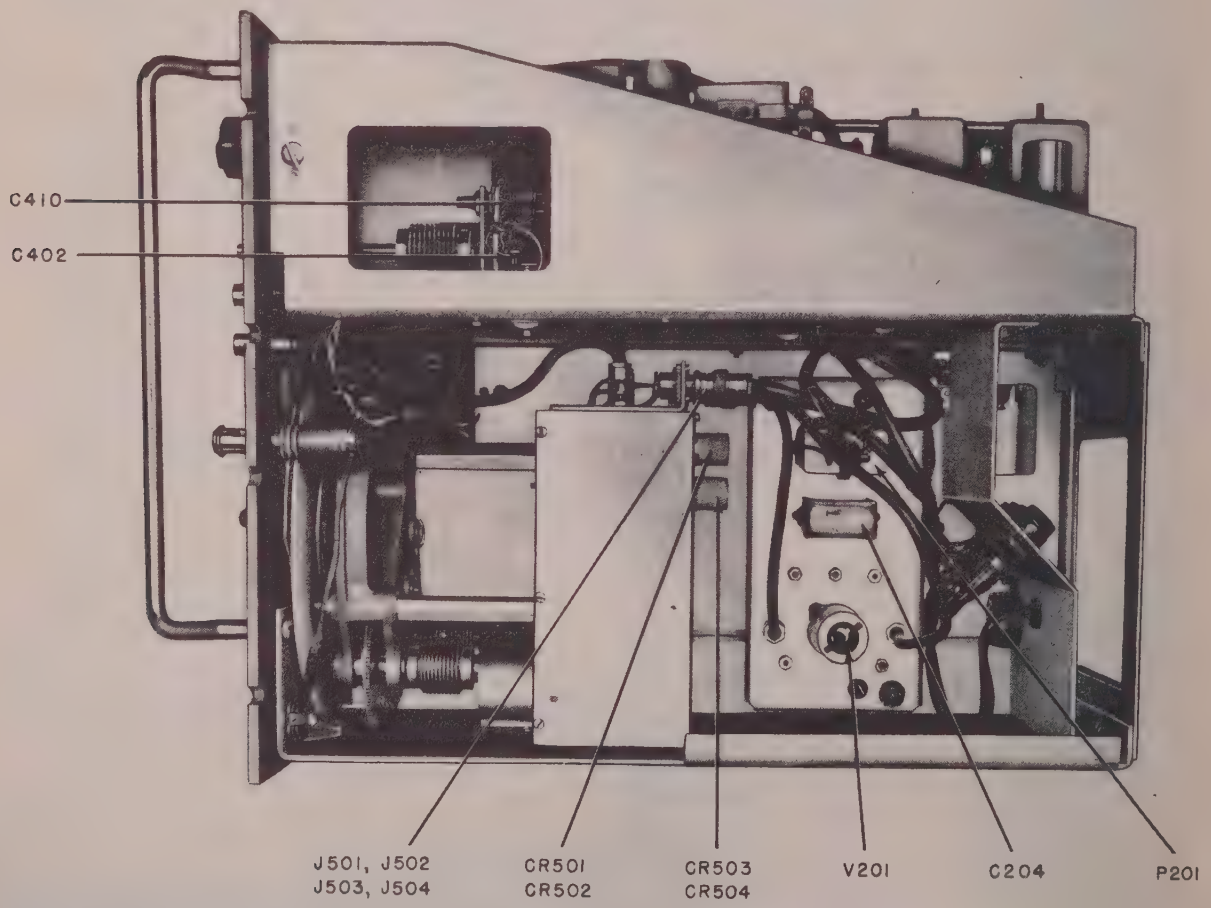


Figure 34. Frequency Meter LA-6, Right Side View, Location of Parts

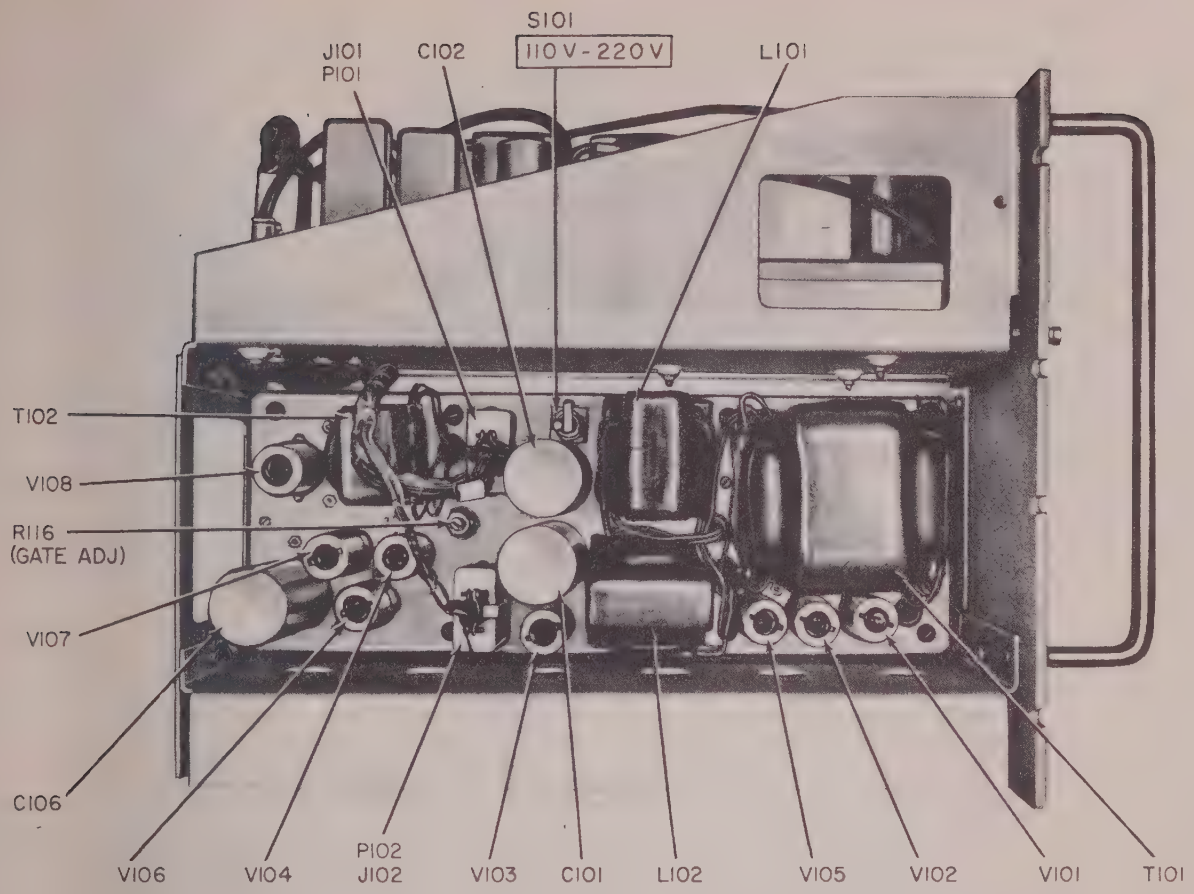


Figure 35. Frequency Meter LA-6, Left Side View, Power Supply Subassembly Location of Parts

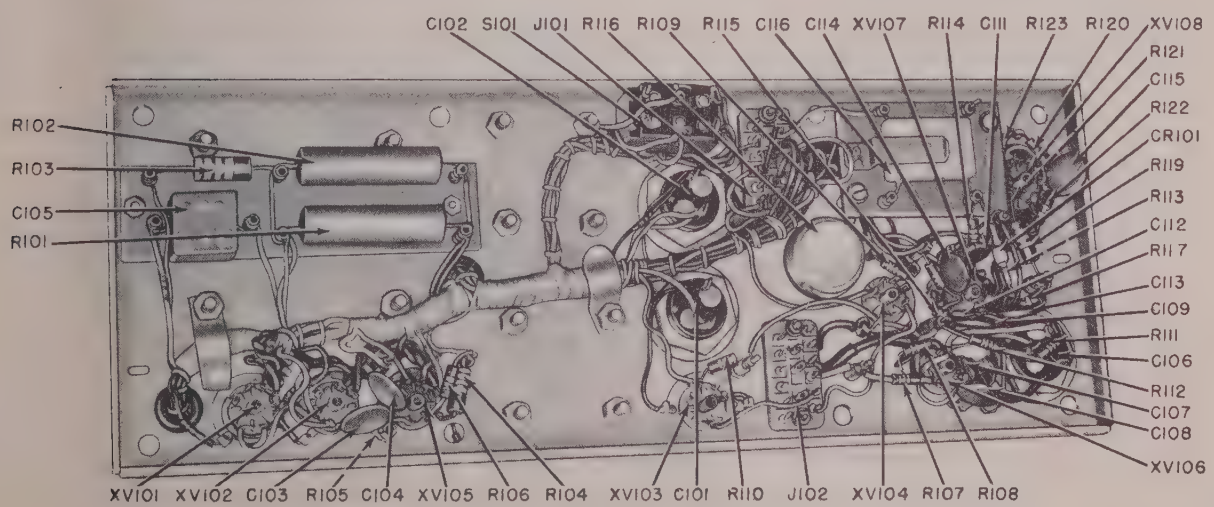


Figure 36. Frequency Meter LA-6, Power Supply Chassis, Bottom View Location of Parts

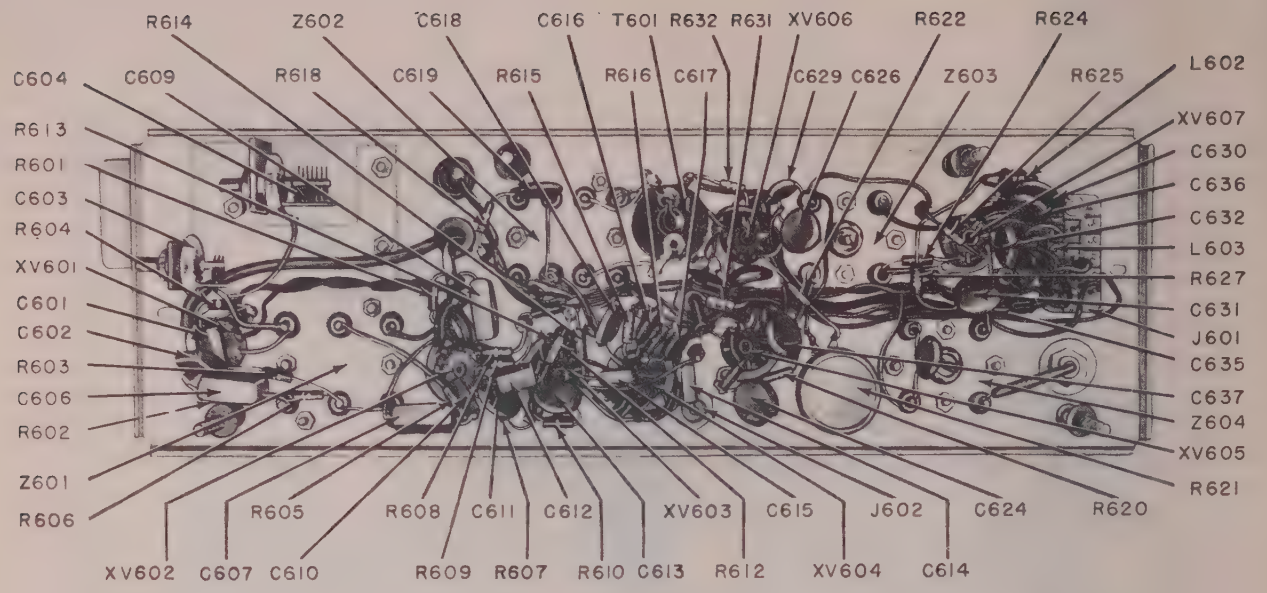


Figure 37. Frequency Meter LA-6, Crystal Oscillator Balanced-Modulator Chassis, Bottom View, Location of Parts

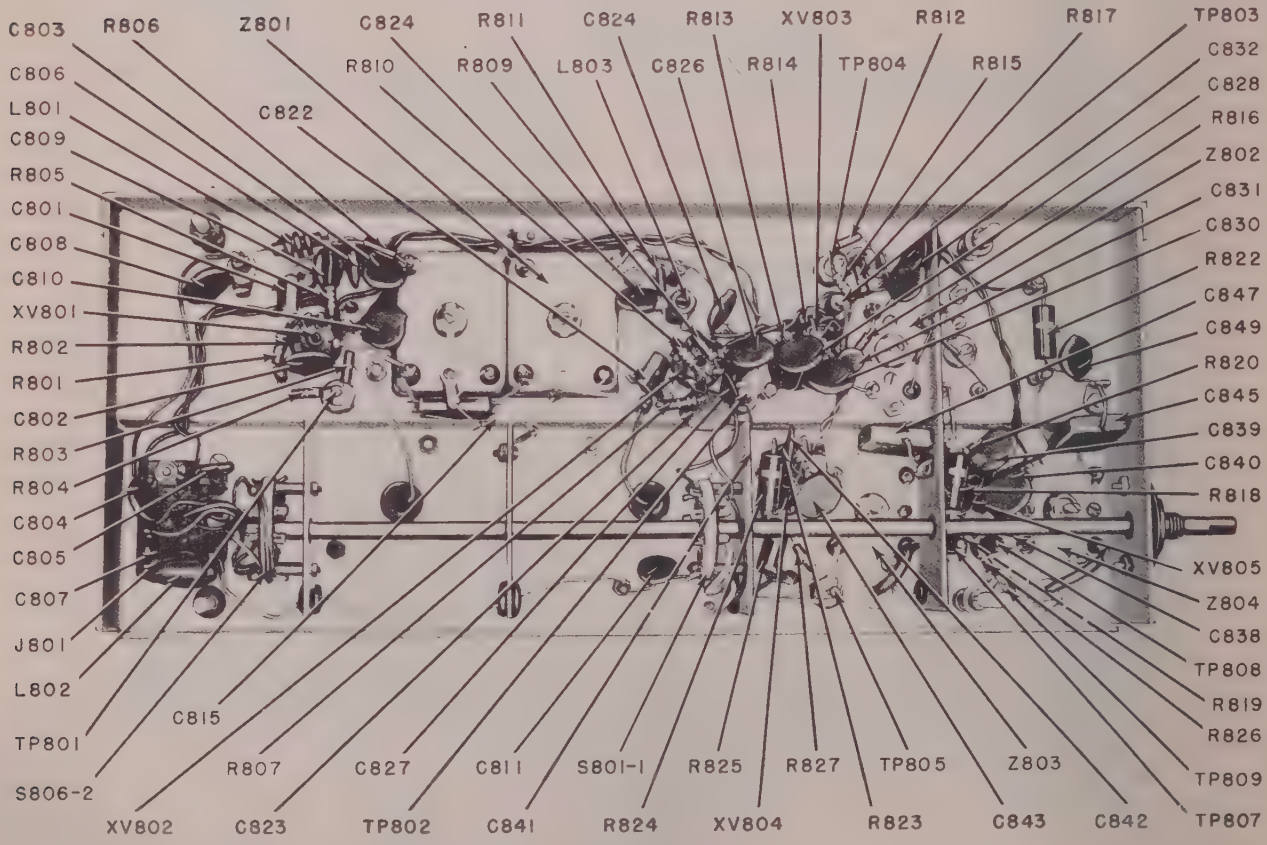


Figure 38. Frequency Meter LA-6, Band-pass Amplifier, Bottom View, Location of Parts

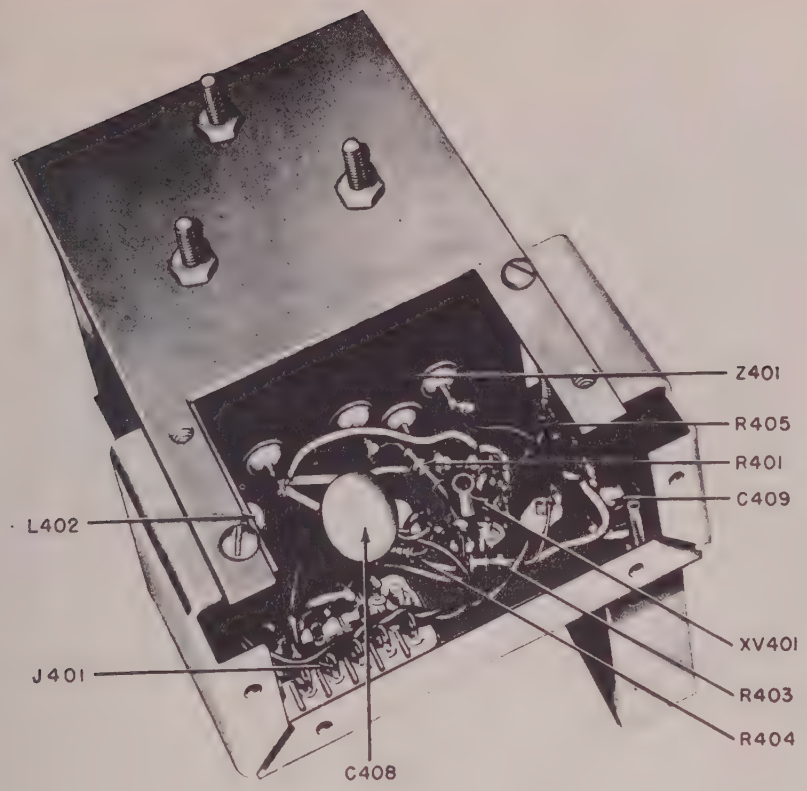


Figure 39. Frequency Meter LA-6, Interpolation Oscillator Chassis, Bottom View Location of Parts

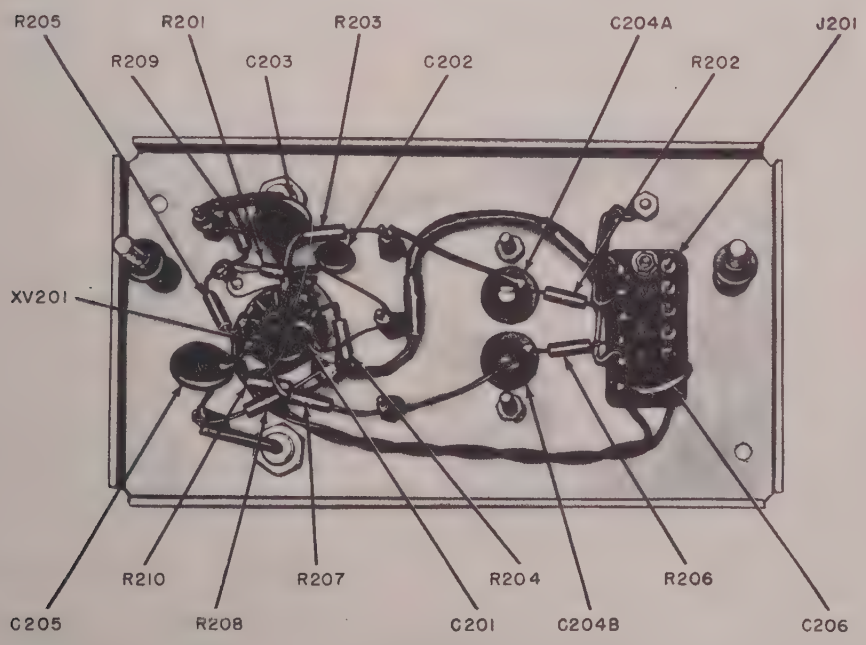


Figure 40. Frequency Meter LA-6, Preamplifier Chassis, Bottom View, Location of Parts

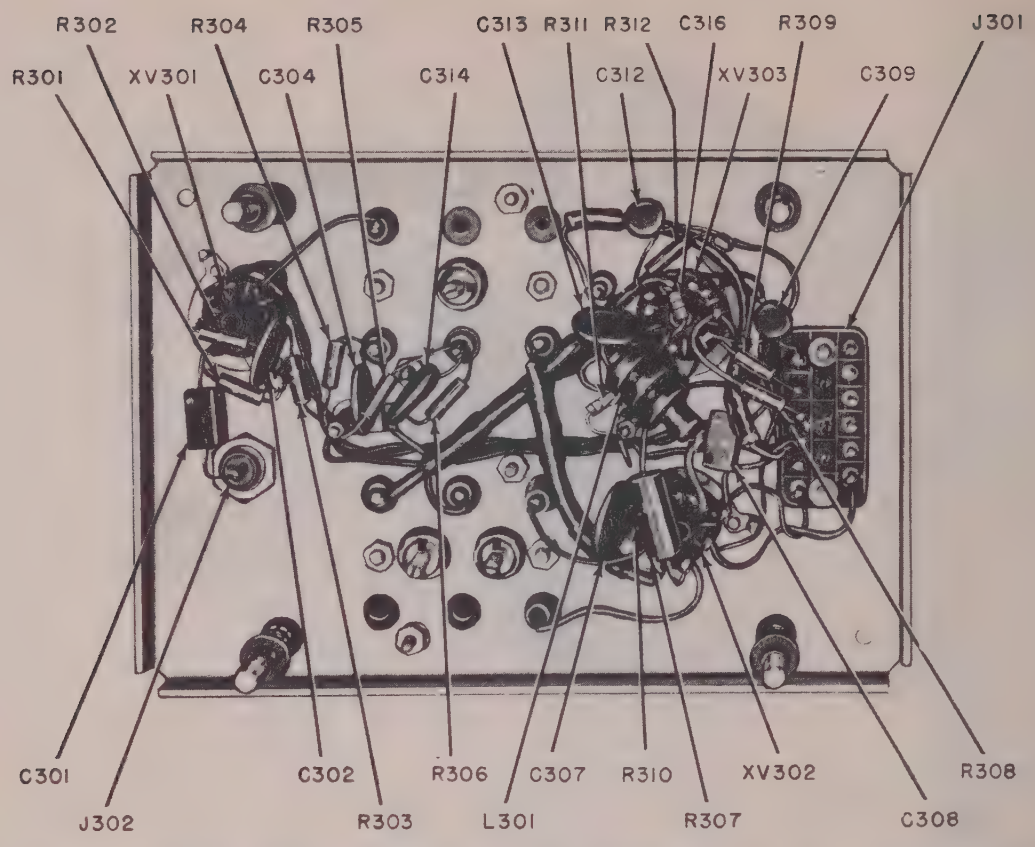


Figure 41. Frequency Meter LA-6, Check System Chassis, Bottom View, Location of Parts

53. Disassembly and Reassembly of Film Mechanism

a. Remove the film mechanism as described above. Disassembly is performed as follows (fig. 42).

(1) Loosen the associated set screws and remove knob (1), then remove the frame assembly (2).
(2) Loosen the set screws and remove the pulley (3).
(3) Remove the attaching screws and remove the film drive assembly (4) from the frame assembly (2).
(4) Remove the attaching shoulder screw (5) and remove the arm (6), pin (7), and spring (8).
(5) Loosen the set screws and remove the cam (9) from the gear (11).
(6) Remove the shoulder screw (10) and gear (11). Remove the attaching shoulder screws (12) and lever stop (13) from the drive assembly.
(7) Remove the spring (14) and grooved pin (15).
(8) Remove the retainer ring (16) and gear and shaft assembly (17).
(9) Disassembly the worm gear (18), ball bearing (19), and gear (20). Extract the ball bearing (21).
(10) Remove the retaining screw (22) from the film frame (23).
(11) Loosen the set screws on the film sprocket (25) and remove the gear and shaft assembly (24).
(12) Remove the spacers (26, 27, and 28).
(13) Remove the shaft (29) and spring (30) from the film roller (31). Remove the spacer (32).
(14) Remove the attaching screws, front window assembly (33), and frame assembly (35). Remove the window (34).
(15) Remove the spring washers and remove the shaft (36) and film roller (37).
(16) Remove the belt (38).
(17) Loosen the two set screws and remove the pulley (39).
(18) Remove the spring washer, slotted shaft (40), and film reel (41).
(19) Loosen the set screws and remove the cover (42), and spring (43) from the gear assembly (44).
(20) Remove the spring washer and slotted shaft (45).
(21) Remove the film reel (46).
(22) Remove the sleeve bearings (47) by knocking them out with a suitable punch.
(23) Remove the attaching screws and remove the film viewer bezel (48) from the front panel.
(24) Remove the hood assembly (49) and sight lens (50).
(25) Remove the terminal (51), lampholder (52), and incandescent lamp (53).

b. To reassemble the film system assembly, reverse the disassembly procedure.

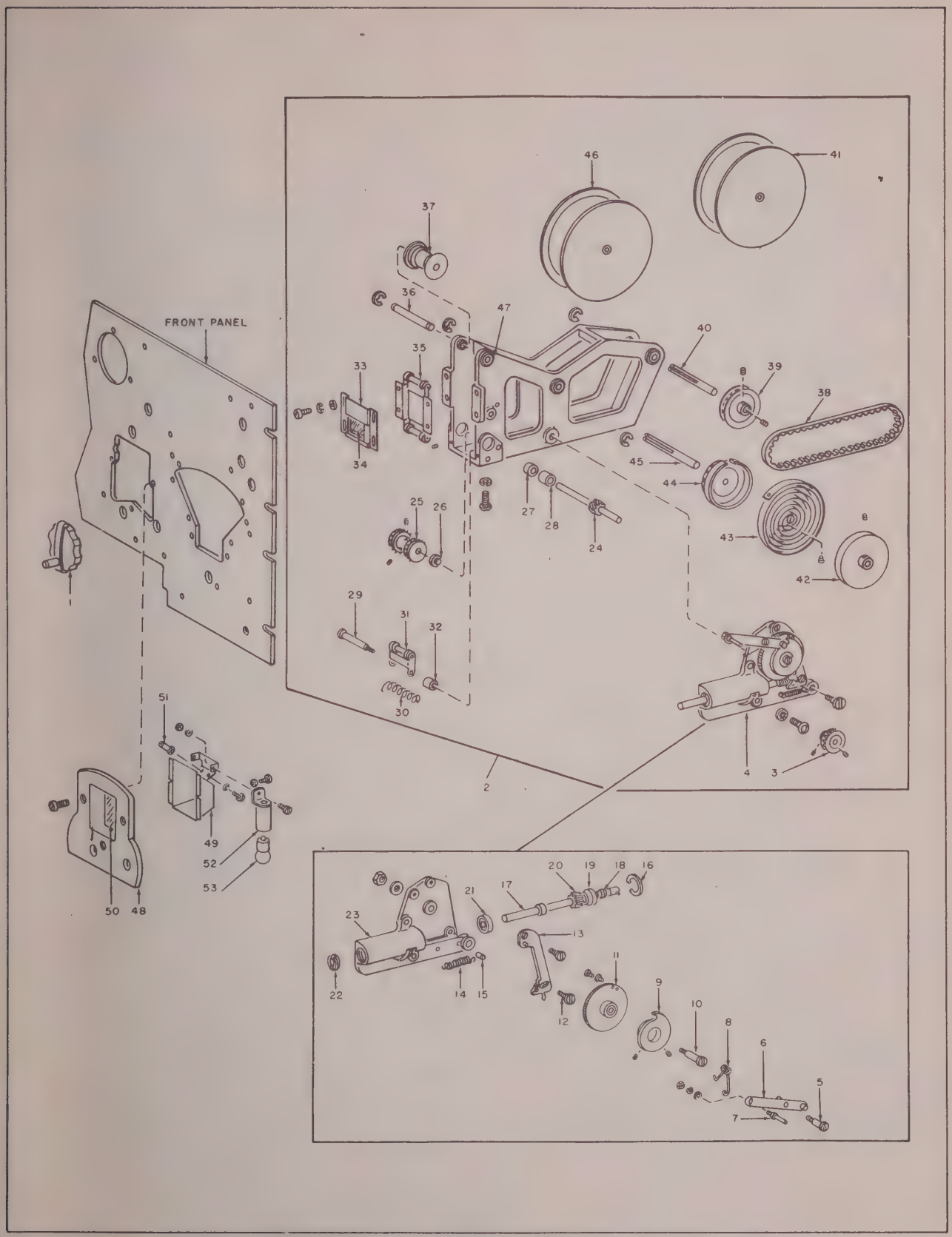


Figure 42. Frequency Meter LA-6, Film Mechanism, Exploded View

54. Removal and Replacement of Crystal Oscillator

a. To remove the crystal oscillator chassis, proceed as follows:

(1) Remove P602 from J602.
(2) Remove P302 from J302.
(3) Remove P601 from J601.
(4) Loosen the four black-headed retaining screws, two on each long side of the crystal oscillator subassembly, until the subassembly can be lifted out of the main frame.
(5) The crystal oscillator subassembly can now be removed.

b. To replace the crystal oscillator subassembly, reverse the procedure in subparagraph a above.

55. Removal and Replacement of Rf Tuner and Drive Subassembly

a. To remove the rf tuner and drive assembly, proceed as follows:

(1) Remove the preamplifier (par. 59a).
(2) Remove P503 and P504 from J503 and J504, respectively.
(3) Remove the two nickel-plated screws and ground posts on the front panel.
(4) The rf tuner and drive assembly can now be removed from behind the front panel.

b. To replace the rf tuner and drive assembly, proceed as follows:

(1) Position the rf tuner carefully behind the front panel in its proper location.
(2) Install the ground posts and secure the tuner with the two nickel-plated screws.
(3) Reconnect P503 to J503 and P504 to J504.
(4) Reinstall the preamplifier as described in paragraph 59b.

56. Removal and Replacement of Power Supply

a. To remove the power supply from the chassis, proceed as follows:

(1) Remove plug P101 from J101.
(2) Remove plug P102 from J102.
(3) Loosen the eight black-headed retaining screws, four located on each long side.
(4) Lift out the power supply.
(5) To remove the power supply chassis cover, remove the black-ringed screws.

b. To replace the power supply on the chassis, proceed as follows:

(1) Replace the power supply chassis cover.
(2) Set the power supply in position and secure it with the eight retaining screws.
(3) Reconnect plug P101 to J101 and P102 to J102.

57. Removal and Replacement of Band-pass Amplifier Subassembly

a. To remove the band-pass amplifier subassembly, proceed as follows:

(1) Remove the belt from the pulley on capacitor C814.

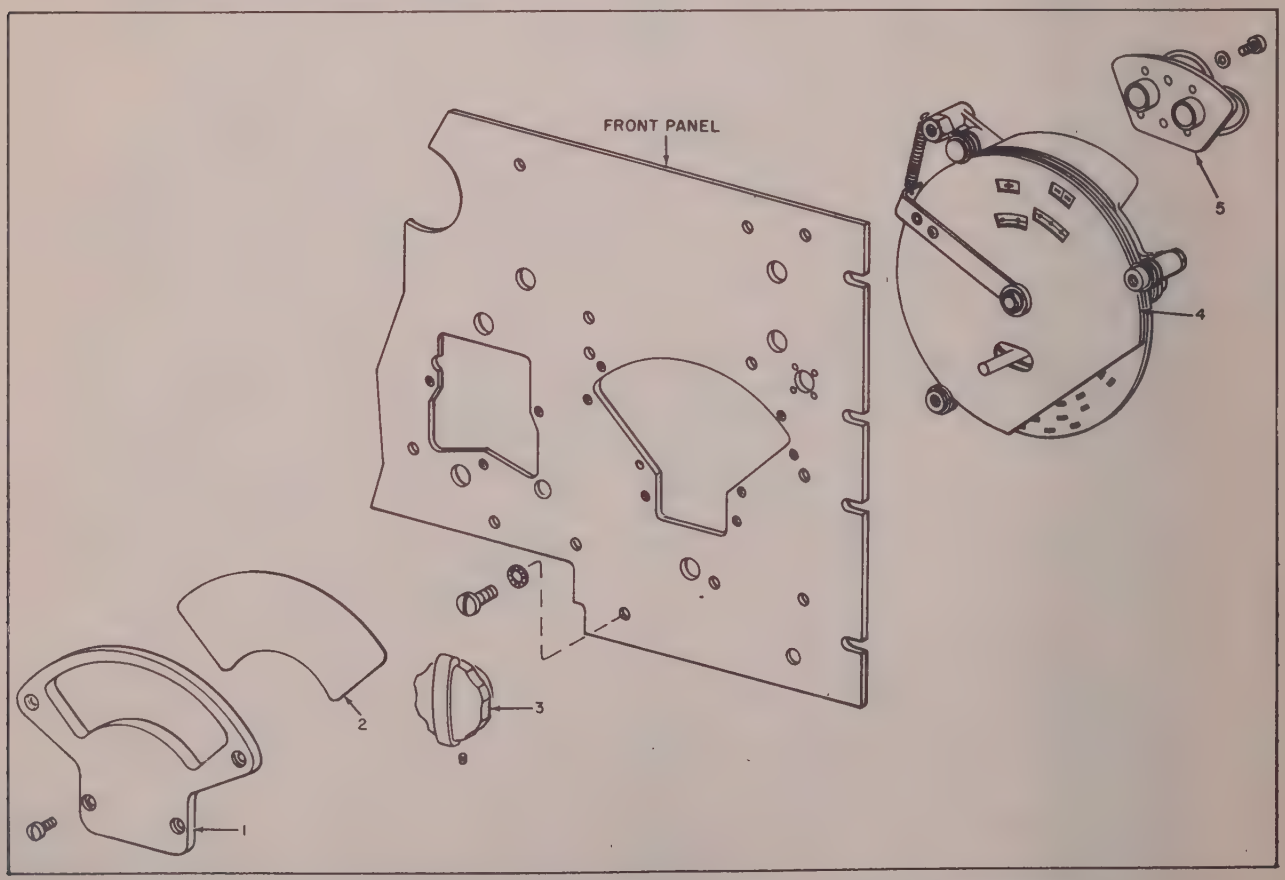


Figure 43. Frequency Meter LA-6, Rf Tuner and Drive Assembly, Exploded View

(2) Remove plug P801 from J801.
(3) Disconnect the three coaxial cables.
(4) Loosen the four black-headed retaining screws, one located in each corner.
(5) Lift out the band-pass amplifier subassembly; be careful not to damage front panel meter M701.

b. To replace the band-pass amplifier subassembly, proceed as follows:
(1) Position the band-pass amplifier subassembly in the main frame.
(2) Tighten the four black-headed retaining screws.
(3) Turn the FINE control so that "014166000" appears in the film window.
(4) Manually turn the plates of tuning capacitor C814 to exactly full mesh.
(5) Replace the drive belt on the capacitor shaft.
(6) Reconnect plug P801 to J801.
(7) Reconnect the three coaxial cables to their proper sockets, as marked on the cables. The band-pass amplifier subassembly is now secured to the chassis.

58. Removal and Replacement of Interpolation Oscillator Subassembly.

a. To remove the interpolation oscillator chassis, proceed as follows:
(1) Remove the CHECK control knob by loosening its two recessed set screws.
(2) Remove the rubber belt between the interpolation oscillator and variable capacitor C814 on the band-pass amplifier subassembly.
(3) Remove the rubber belt between the film drive and the large gear on the interpolation oscillator.
(4) Remove plug P401 from J401.
(5) Loosen the three black-headed retaining screws.
(6) Remove P503 and P504, and push the coaxial cable aside.
(7) Lift the interpolation oscillator off the main frame.

b. To replace the interpolation oscillator subassembly, proceed as follows:
(1) Replace the interpolation oscillator on the main frame.
(2) Tighten the three black-headed retaining screws.
(3) Turn the FINE control so that "014166000" is centered in the film window.
(4) Turn the COARSE control fully counterclockwise (lowest numbers on the band dial).
(5) Replace the rubber drive belt on the large gear wheel that drives C403.
(6) Turn the rotor of capacitor C814 to exactly full mesh.
(7) Replace the rubber drive belt on the shaft of C814.
(8) Reconnect P401, P503, and P504 to their respective jacks.
(9) Recalibrate the interpolation oscillator to the film strip as outlined in paragraph 52b(4) through (13).
(10) Turn the FINE control to the lowest check point on the film strip. Zero-beat this check point. If the zero beat occurs only slightly off this point, proceed as instructed in subparagraph (11) below. If it occurs more than two readings away from the check point, proceed as instructed in subparagraph (12) below. After checking the low end of the band, repeat the procedure at the high end of the band; that is, at the last check point on the film. It may be necessary to check the high and low ends alternately and to shift the pulley on the interpolation oscillator and C402 each time until the final adjustment is achieved.
(11) Center the check point in the window and adjust the CHECK control so that the zero beat is heard again.
(12) Remove the rubber drive belt from the film mechanism and turn the film shaft so that the check point is centered in the window; then replace the drive belt. If the zero beat does not now occur exactly at the check point, proceed as instructed in subparagraph (10) above.

59. Removal and Replacement of Preamplifier Subassembly

a. To remove the preamplifier subassembly, proceed as follows:
(1) Remove plug P201 from jack J201.
(2) Remove P501 from J501, and P502 from J502.
(3) Loosen the two black-headed retaining screws.
(4) Remove the subassembly from the right side of the main frame.

b. To replace the preamplifier subassembly, proceed as follows:
(1) Secure the subassembly to the main frame by tightening the two black-headed mounting screws.
(2) Connect the two coaxial cables.
(3) Connect plug P201 and jack J201.

60. Removal and Replacement of the Check System Subassembly

a. To remove the check system subassembly, proceed as follows:
(1) Disconnect plug P301 and jack J301.
(2) Disconnect coaxial fitting J302.
(3) Loosen the four black-headed mounting screws.
(4) Lift the check system subassembly from the main frame.

b. To replace the check system subassembly, reverse the disassembly procedure in subparagraph a above.

61. Test Equipment Required for Calibration and Alignment

The following test equipment is required for calibration and alignment of Frequency Meter LA-6.

ITEM
Electron Multimeter (TS-505/U
Frequency Meter Calibrator Set (AN/URM-18)
Multimeter (TS-352/U)
Oscilloscope (OS/8A/U)
Q Meter (TS-617/U)
Radio Receiver (R-390/URR)
Signal Generator (TS-497/URR)
Signal Generator (AN/URM-25)
Voltmeter (ME-30A/U)
Adaptor (UG-274/U)

62. Crystal Oscillator Alignment

This paragraph contains the alignment procedures for the crystal oscillator. The following test equipment is required: a receiver with a 4-mc range and equipped with an S-meter, such as Radio Receiver R-390/URR; a signal source of 4-mc or some submultiple thereof which has been derived from, or is compared to, a standard having an accuracy of one part in 10 million, such as Frequency Meter Calibrator Set AN/URM-18; and an oscilloscope with good response to above 400 kc, such as Oscilloscope OS-8A/U.

a. Compensation for Crystal Aging. Because of the aging of a crystal, frequency correction is necessary once a month for the first 6 months and every 6 months thereafter. To maintain maximum accuracy, the crystal oscillator must be regularly compared to a standard frequency source and, if necessary, adjusted. Proceed as follows:

(1) Connect 4 MC CRYSTAL OUTPUT J701 to the vertical amplifier input of the oscilloscope.
(2) Connect the output (4-mc) of the frequency standard to the horizontal amplifier input of the oscilloscope.
(3) A Lissajous pattern will result on the oscilloscope tube. Remove three of the screws that secure the nameplate and push the name plate aside to reach 4 MC ADJUST control C603.
(4) Adjust C603, with a screw driver, until the pattern is absolutely stationary. The crystal oscillator is now accurately tuned to 4-mc.

b. Alternate Method of Crystal Oscillator Alignment.

(1) Connect a cable from the 4 MC CRYSTAL OUTPUT jack to the antenna terminals of the receiver.
(2) Connect the standard signal source to the antenna terminals.
(3) Tune the receiver to 4-mc. With receiver's BFO off, a low frequency audio tone will be heard in the headphones.
(4) Remove all screws, except the lower right, one from the front panel name plate, and pivot plate on that screw; this exposes 4 MC ADJUST control.
(5) Turn the 4 MC ADJUST control to decrease the frequency of the audio tone by using a screw driver. As the frequency nears zero, observe oscillation of the S-meter pointer. Continue to adjust the control until the pointer ceases to move. The crystal oscillator now is accurately tuned to 4-mc.

c. Compensation for Changed Components. If the crystal oven unit or tube V601 is changed, more correction may be required than can be achieved by the procedure described in subparagraph a and b above. Then modify the procedure as follows:

(1) Set the 4 MC ADJUST control to the mid-position, as evidenced by a horizontal slot orientation.
(2) Turn variable capacitor C604 (fig. 37) to obtain the zero beat described in subparagraphs a and b above.

63. Balance-modulator Alignment

a. The balanced-modulator required alignment if, when in FINE tuning, substantial signals, less than 40 db down from normal signal output, can be found without application of an input signal, or if the output from P802 is less than 1.5 volts at any frequency setting of the FINE tuning dial. The tubes must be checked and replaced if necessary before alignment. Radio Receiver such as R-390/URR and an Electronic Multimeter such as ME-30A/U are required.

b. Some of the adjustments mentioned in the following procedure are on the underside of the balanced-modulator chassis. Loosen the subassembly holding screws and turn the unit so that the underside is accessible. If necessary, remove P602; do not remove any of the other connections. The frequency meter must be turned on and sufficient warm-up time allowed. Refer to figures 32 and 37 for location of alignment slugs. It is not necessary to remove the base plate.

(1) Remove V606 and replace it with a 5725 tube, which has one filament pin, 3 or 4, cut off. Set balance control R621 to approximately the center of its rotation.
(2) Couple the control grid, pin 1, of V607 through a 1-micromicrofarad (uuf) capacitor and a shielded cable to the receiver. Tune the receiver to 4-mc
(3) Tune slugs A and B of Z602 for maximum deflection on the receiver tuning meter. It may be necessary to alternate the adjustment of these slugs to attain maximum deflection.
(4) Remove the dead 5725 and replace it with V606. Allow 10 minutes for the tube to warm up. Tune the interpolation oscillator to a film indication of 4166000.
(5) Adjust balance control R621 for minimum meter deflection on the receiver.
(6) Remove the receiver coupling from V607. Connect the probe of the ME-30A to terminal 3 of Z604, or directly to P802, through a 1-uuf capacitor.
(7) Tune slug B of Z603 for maximum meter indication.
(8) Tune the interpolation oscillator to a film

indication of 4340000. Tune slug B of Z604 for the same level indication as in subparagraph (7) above.

(9) Tune the interpolation oscillator over the entire range and observe meter. The indication should be constant within 2 db. If this is not the case, readjust slug B of Z604 for minimum variation in output.

64. Check System Alignment

a. To align the check system, a signal generator and a frequency meter capable of measuring 8 mc are required. Proceed as follows:

b. Energize the signal generator and allow sufficient warm up time. Set the signal generator exactly to 8 mc by using the frequency meter.

c. Remove P302 from J302 and connect the output of the signal generator to J302. Energize the LA-6 and allow it to warm up.

d. Turn the FUNCTION SWITCH to the CHECK. Remove V401.

e. Switch the audio modulation on in the signal generator.

f. Tune slugs A and B of Z301 and slugs A, B, and C of Z302 (fig. 32 and 41) for maximum audio output at the PHONE jack.

g. Replace V401. The check system is now accurately aligned.

65. Band-pass Amplifier Alignment

To align the band-pass amplifier will require the use of a Q Meter such as TS-617/U, an Electronic Multimeter (TS-505/U), Adaptor (UG-274/U), and a receiver tunable to 4-mc (Radio Receiver R-390/URR). It will be necessary to have access to the underside of the band-pass amplifier chassis. All adjustments are stamped on the underside of the chassis.

a. Trimmer Alignment. Trimmer capacitors C812, C816, C818, and C820 usually do not require adjustment, but should be adjusted if one of these is accidentally changed in setting or if any of the trimmers or associated shunting fixed mica capacitors are replaced.

(1) Disconnect the following leads at one end only: jumper lead from terminal 2 of Z801 to pin 5 of V801, the white lead from C816 to terminal 7 of Z801, white lead from C818 to terminal 8 of Z801, and the green lead from terminal 5 of Z801 to the tie point. Do not disturb C815. Carefully place loose wires out of the way to avoid short circuits.

(2) Set up the Q-meter with a suitable coil and resonate it at 4 to 5 mc by a 200-uuf capacitor. Attach 3-inch rigid clip leads to the C terminals of the Q-meter before resonating.

(3) Connect the ground clip lead to frame of C814.

(4) Connect the high clip lead to C814A stator, and set C814 to half mesh.

(5) Set the Q-meter capacitor at 65 uuf (a change of 135 uuf).

(6) Adjust C812 for maximum reading on the Q-meter.

(7) Move the high clip lead to the stator of C814B.

(8) Adjust C816 for maximum reading on the Q-meter.

(9) Move the high clip lead to the stator of 814C.

(10) Adjust C818 for maximum reading on the Q-meter.

(11) Move the high clip lead to the stator of C814D.

(12) Adjust C820 from maximum reading on the Q-meter.

(13) Replace all the wires that were removed in subparagraph (1) above.

b. Network Alignment. Realignment of the various networks in the band-pass amplifier may be required if the output is too low, as evidenced by an indication of less than negative 30-volts dc at TP805, with the RANGE switch in the 100-225 MC position, or TP809, with the RANGE switch in the 225-500 MC position, as measured on a 20,000 ohms per voltmeter. Before proceeding with realignment, check, and replace if necessary, the tubes in the band-pass amplifier; check the tracking of the band-pass amplifier tuning capacitor with the interpolation oscillator tuning capacitor; check the output of the balanced modulator; and change crystals CR501 and CR502 in the rf tuner. The band-pass amplifier must be removed from its position in the main frame (par. 57) for network realignment, but all interconnections must be intact.

(1) Alignment of Z801. Set the FUNCTION SWITCH to FINE and the RANGE switch to 100-225 MC. Place Adapter (UG-274/U) on jack J802. Connect P802 to one side of the tee and a 1,000-ohm carbon variable resistor to the other side of the tee and between center and outer conductors. Set the interpolation oscillator film to 4253000. Connect a vacuum-tube voltmeter (vtvm) to TP801, and short stator of C814B to the frame.

(a) Tune C814 for maximum meter reading. Adjust the carbon potentiometer to reduce meter reading for sharpest tuning, approximately .3 volt on the meter. Set C814 at approximately 90° out of full mesh; turn it clockwise as viewed from the front.

(b) Adjust slug A of Z801 for maximum meter reading. Move short from C814B stator C814C stator.

(c) Adjust slug B of Z801 for minimum meter reading. Move short from C814C stator to C814D stator.

(d) Adjust slug C on Z801 for maximum meter reading. Remove short from C814D stator.

(e) Adjust slug D of Z801 for minimum reading. This completes the alignment of Z801.

(2) Alignment of L803. Connections and equipment should be set up as at conclusion of preceding procedure. Disconnect the vtvm from TP801. Set the multimeter to the 50-volt range. Connect the negative lead to TP805 and the positive lead to the band-pass amplifier chassis. Adjust slug L803, located on the chassis main frame, for maximum meter reading.

(3) Alignment of Z803. Connections and equipment should be set up as at conclusion of preceding procedure.

(a) Shunt terminals 3 and 4 of Z803 with a

1,000-ohm, 1/2-watt composition resistor.
(b) Tune slug A of Z803 for maximum meter reading. Transfer the 1,000-ohm shunt resistor from terminals 3 and 4 to terminals 1 and 2 of Z803.
(c) Tune slug B of Z803 for maximum meter reading. Remove shunt.
(d) Check the meter reading at both ends of the interpolation oscillator range and make it uniform by adjusting slug B of Z803.

(4) Alignment of Z802. The connections and equipment should be set up as at the conclusion of the preceding procedure.
(a) Disconnect the multimeter lead from TP805. Connect the vtvm to TP804 and the chassis. Set the RANGE switch to 225-500 MC.
(b) Ground pin 7 of Z802 and adjust slug A of Z802 for a maximum vacuum - tube - voltmeter (vtvm) reading. Remove the ground from pin 7 and ground pin 8 of Z802.
(c) Tune slug B of Z802 for minimum reading on the vtvm. Remove the ground pin 8 and ground pin 5 of Z802.
(d) Tune slug C of Z802 for maximum meter reading. Remove the ground from pin 5 of Z802.
(e) Tune slug D of Z802 for minimum meter reading.

(5) Alignment of Z804. Connections and equipment should be set up as at the conclusion of the preceding procedure.
(a) Disconnect the vtvm.
(b) Set the multimeter to the 50-volt range. Connect the negative lead to TP809 and positive lead to the chassis.
(c) Shunt terminals 3 and 4 of Z804 with a 1,000-ohm, 1/2-watt composition resistor.
(d) Tune slug A of Z804 for maximum meter reading.
(e) Transfer shunt resistor from terminals 3 and 4 to 1 and 2 of Z804.
(f) Tune slug B of Z804 for maximum meter reading.
(g) Remove shunt. Check the meter reading at both ends of the interpolation oscillator range, and equalize the reading by adjusting slug B of Z804.

(6) Adjustment of C815.
(a) Connect the receiver input to TP802.
(b) Set the film strip to read 4166000.
(c) Set C814 to maximum capacitance.
(d) Tune the receiver to 4 mc, and adjust the receiver gain for convenient meter reading. Use a nonmetallic tuning tool.
(e) Adjust the wires of C814 to provide minimum meter reading. Use a nonmetallic tuning tool.

66. Meter and Gate Adjustments

a. Equipment Required. Adjustment of meter potentiometer R703 and gage potentiometer R116 require the use of a signal generator (such as Signal Generator TS-497B/URR) with a calibrated output and an ac meter (such as Electronic Multimeter ME-30A/U).

b. TUNING METER Adjustment (R703).
(1) Set the FUNCTION SWITCH to COARSE and the COARSE tuning dial to 230 mc on band II. Turn the LEVEL control fully clockwise.
(2) Adjust the signal generator to provide a 230-mc, 10-millivolt output. Connect the signal generator output to 225-500 MC RF INPUT jack J704.
(3) Set the COARSE tuning dial for a maximum reading on the TUNING METER and/or maximum audio output.
(4) Adjust R703 until the indicator reaches the high end of the green block on the TUNING METER.

c. Gate Adjustment (R116).
(1) Set the FUNCTION SWITCH to COARSE and the COARSE tuning dial to 230 mc on band II. Turn the LEVEL control fully clockwise.
(2) Adjust the signal generator to provide a 230-mc, 1-millivolt output. Connect the signal generator output to 225-500 MC RF INPUT jack J704.
(3) Set the COARSE tuning dial for a maximum reading on the TUNING METER.
(4) Set the LEVEL control so that the needle reaches the high end of the green block.
(5) Connect a 600-ohm noninductive resistor and an Electronic Multimeter (ME-30A/U) across PHONE jack J703.
(6) Adjust gate potentiometer R116 to provide a reading of 0 dbm (1 milliwatt) on the multimeter.

67. General

This section is a guide to be used in determining the quality of a repaired Frequency Meter LA-6. The minimum test requirements outlined in paragraphs 67 through 69 below may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

68. Test Equipment Required for Final Testing

The test equipment required for final testing is as follows:

ITEM

Frequency Calibrator Set (AN/URM-18)
Signal Generator (TS-497B/URR)
Calibrator Set (AN/USM-45)
Voltmeter (ME-30A/U)

69. Tests

Perform the following tests at three equally spaced frequencies in the low, center, and high regions of each band (six times). If, during the performance of these tests spurious responses are noted, check each response according to the instructions in paragraph 70. Perform the tests in the order given for each frequency selected, rather than performing a particular test at all frequencies, the next test at all frequencies and so on.

a. Accuracy

(1) Connect the rf cable from the appropriate RF INPUT jack to Frequency Calibrator Set (AN/USM-45) so that the harmonic output of the calibrator set feeds the Frequency Meter LA-6.

(2) Connect the CRYSTAL OUTPUT of the Calibrator Set (AN/USM-45) to Frequency Calibrator Set (AN/URM-18). The Frequency Calibrator Set (AN/URM-18) is used to monitor and check the crystal output of the Calibrator Set AN/URM-45) to insure an accurate and stable output.

NOTE. The second, third, and fourth harmonics of the calibrator set is used for checking band I. The fifth through ninth harmonics of the calibrator set are used for checking band II.

(3) The frequency meter should measure each frequency to an accuracy of .001 per cent.

b. Sensitivity, Audio Output and Signal-to-noise Ratio. To perform these checks, proceed as follows:

(1) Set the FUNCTION SWITCH to COARSE, and the COARSE tuning dial to 150 mc on band I. Turn the LEVEL control fully clockwise.

(2) Connect the rf output of Signal Generator (TS-497/URR) to the RF INPUT jack and adjust the output attenuator to 10 microvolts (uv) unmodulated output. Tune the signal generator near 150 mc until a tone is heard in the headphones or until the tuning meter indicates upscale.

(3) Connect a 600-ohm noninductive resistor and Voltmeter (ME-30A/U) across the PHONES jack and adjust the COARSE tuning for maximum audio output.

(4) Adjust the signal generator attenuator to provide 1 milliwatt output (0 dbm). Record this input voltage as coarse sensitivity. It must be 10 microvolts or less. Reduce the signal generator output to zero. If the audio output drops at least 1 db below 1 milliwatt (mw), the signal-to-noise ratio is normal.

(5) Set the FUNCTION SWITCH to FINE, turn the signal generator attenuator to 10 mv, and tune for zero beat. Detune slightly for maximum indication on audio voltmeter.

(6) Adjust the signal generator output to provide 0 dbm audio output. Record this input voltage as the fine sensitivity. It must be 10 millivolts (mv) or less. Reduce signal generator output to zero. If the audio output drops at least 1 db below 1 mw, the signal-to-noise ratio is normal.

(7) Satisfactory results from the tests described above will indicate that the audio output and the signal-to-noise ratio are within allowable limits.

70. Spurious Responses

To check for spurious responses in the rf tuner proceed as follows:

a. With the equipment set up as described in paragraph 69, place the FUNCTION SWITCH in the COARSE position and flip the frequency meter through the band; when a spurious response is obtained, tune the COARSE control for a maximum indication on the TUNING METER, or if the signal can be heard, for a maximum audio output.

NOTE. The amplitude of the injected signal should be such that the TUNING METER reads near the top of the green area, with the level control set fully clockwise when the COARSE frequency control is set to the input frequency.

b. Disconnect the headphones, and connect a 600-ohm, noninductive resistor in parallel with the Voltmeter (ME-30A/U) to the PHONE jack. Measure the voltage across the resistor.

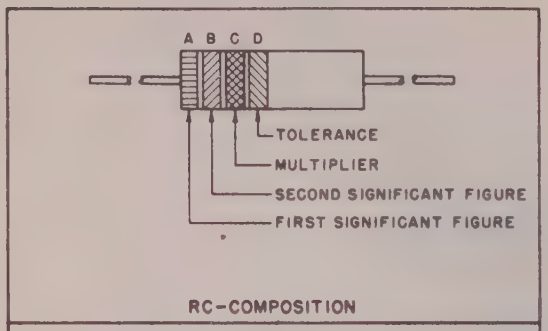
c. Disconnect the 600-ohm resistor and the voltmeter and reconnect the headphones. Complete the measurement of the unknown frequency in the COARSE position only.

d. When the TUNING METER has been maximized, disconnect the headphones, reconnect the 600-ohm load and, again measure the voltage across the load.

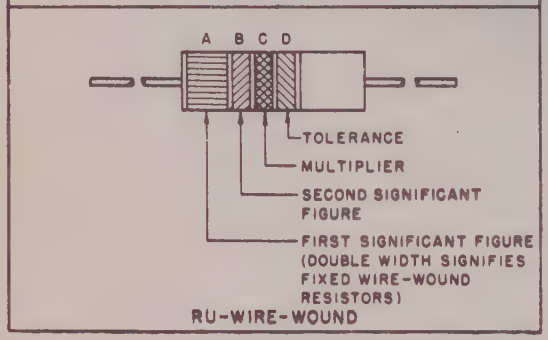
e. The previous measurement of spurious response should be 40 db down from the measurement of the desired response. If this 40 db difference cannot be obtained, refer to paragraph 66c.

RESISTOR COLOR CODE MARKING
(MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)

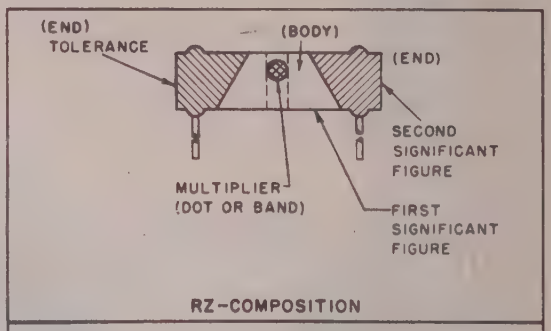


RC-COMPOSITION

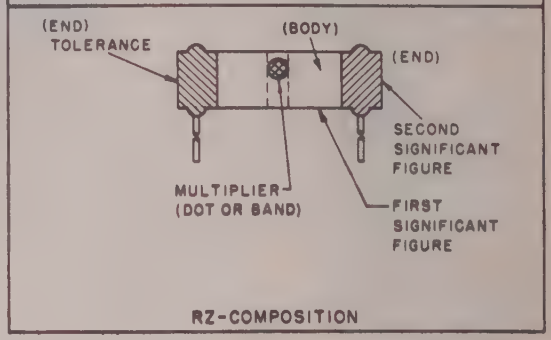


RU-WIRE-WOUND

RADIAL-LEAD RESISTORS (UNINSULATED)



RZ-COMPOSITION



RZ-COMPOSITION

RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1	BODY	± 20
BROWN	1	BROWN	1	BROWN	10	SILVER	± 10
RED	2	RED	2	RED	100	GOLD	± 5
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

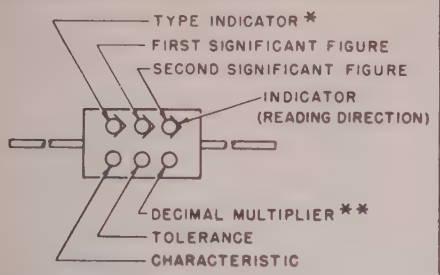
*FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

EXAMPLES (BAND MARKING):
10 OHMS ±20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
4.7 OHMS ±5 PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

EXAMPLES (BODY MARKING):
10 OHMS ±20 PERCENT: BROWN BODY; BLACK END; BLACK DOT OR BAND; BODY COLOR ON TOLERANCE END.
3,000 OHMS ±10 PERCENT: ORANGE BODY; BLACK END; RED DOT OR BAND; SILVER END.

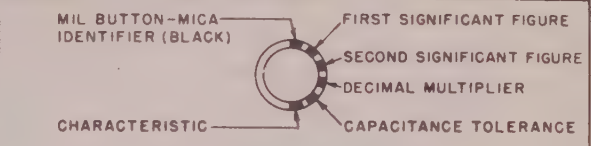
Figure 44. Resistor Color Codes

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)

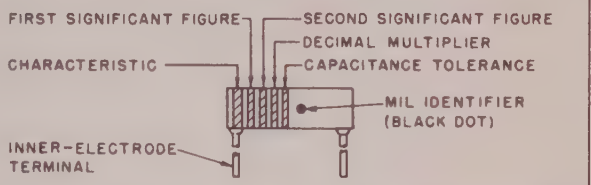


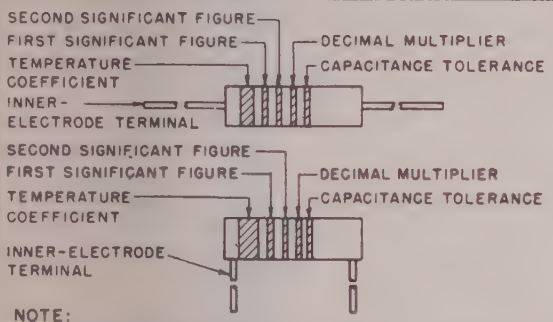
* BLACK DOT: MICA DIELECTRIC
SILVER DOT: PAPER DIELECTRIC
** INDICATES NUMBER OF ZEROS ON PAPER TYPE.

MICA (CM) AND PAPER (CN)



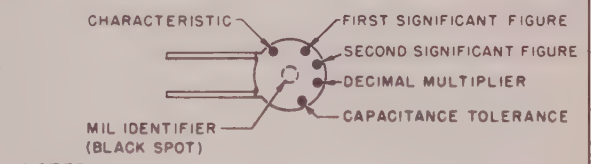
BUTTON-MICA (CB)





NOTE:
SPOTS MAY BE USED INSTEAD OF BANDS; TEMPERATURE COEFFICIENT MARKING IS LARGER.

CERAMIC-TEMPERATURE COMPENSATING (CC)



NOTES:
1. SPOTS MAY BE USED ON TUBULAR CAPACITORS; CHARACTERISTIC SPOT IS LARGER AND MIL IDENTIFIER IS ON SIDE DIAMETRICALLY OPPOSITE COLOR SPOTS.
2. MIL IDENTIFIER OF DISK TYPE IS ON REVERSE SIDE; CHARACTERISTIC SPOT IS LARGER OR SPACE BETWEEN CHARACTERISTIC AND TOLERANCE SPOTS IS THREE TIMES SPACE BETWEEN ADJACENT SPOTS.
3. TOLERANCE: YELLOW, +100%, -20%.

CERAMIC-GENERAL PURPOSE (CK)

CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE [2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330(±500) [3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

Figure 45. Capacitor Color Codes

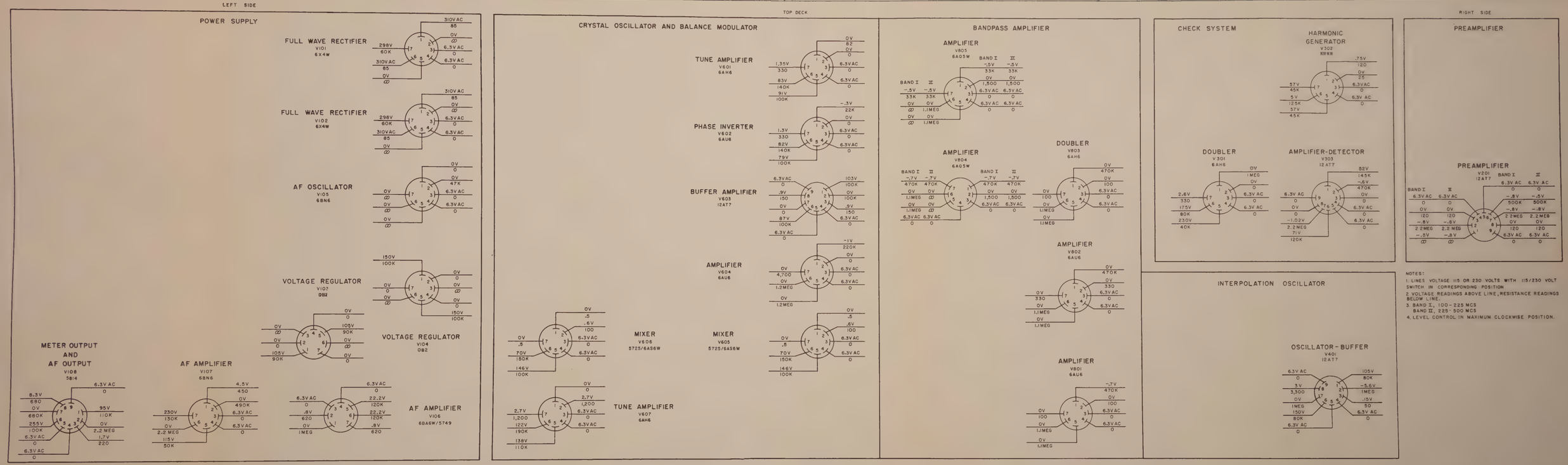
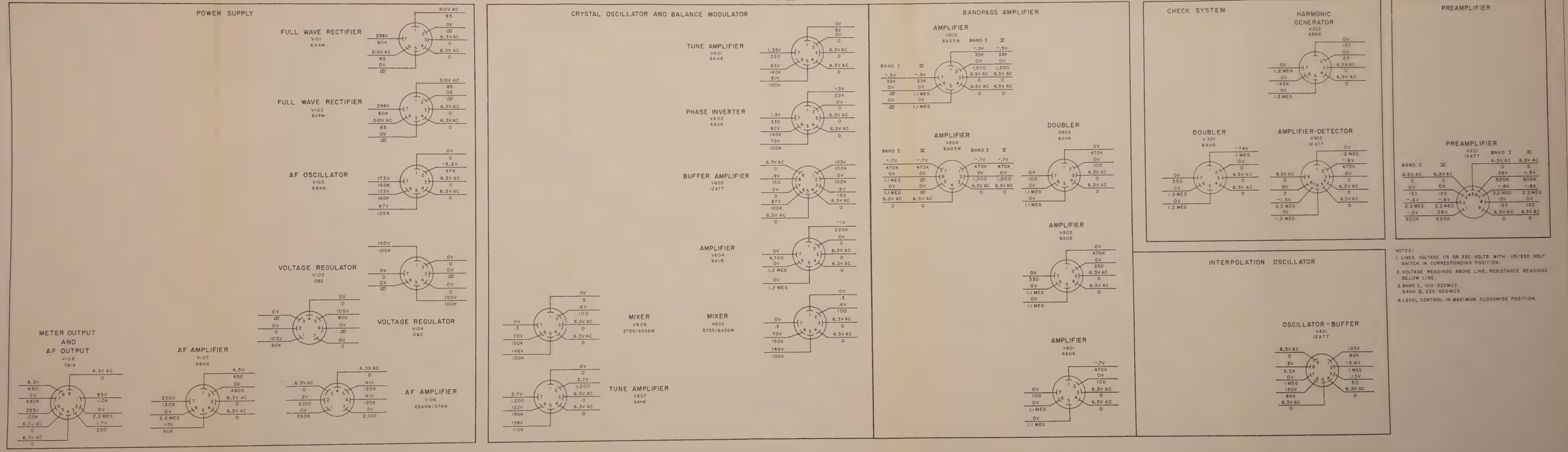


Figure 46. Frequency Meter LA-6, Tube Socket Voltage and Resistance Diagram CHECK, position

LEFT SIDE

TOP DECK

RIGHT SIDE



NOTES:

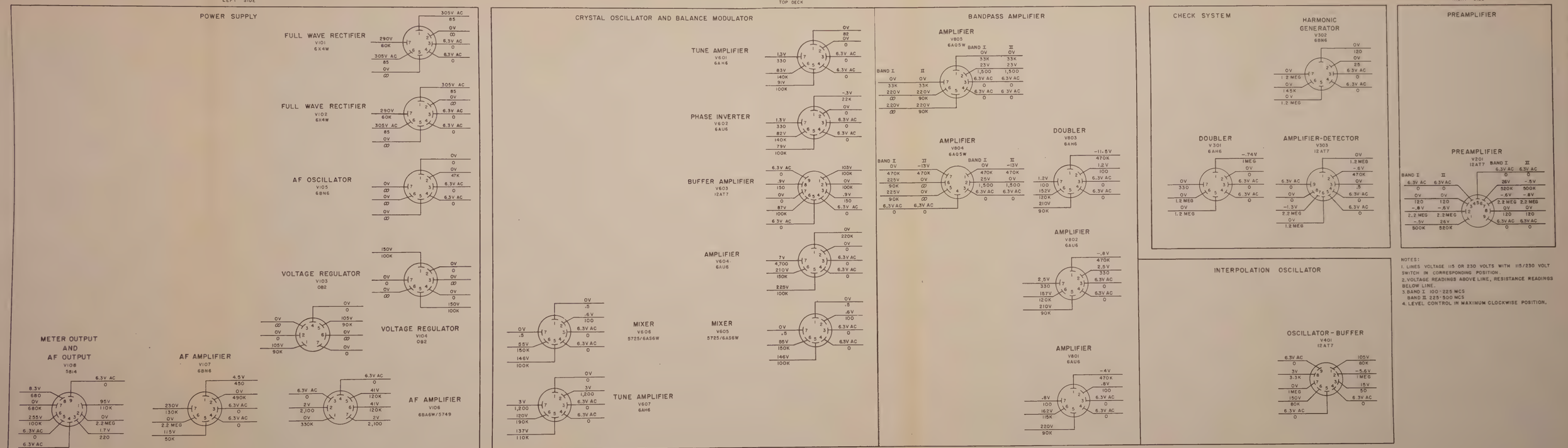
1. LINES VOLTAGE 115 OR 230 VOLTS WITH 115/230 VOLT SWITCH IN CORRESPONDING POSITION.
2. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.
3. BAND I, 100-225MCS
   BAND II, 225-500MCS
4. LEVEL CONTROL IN MAXIMUM CLOCKWISE POSITION.

Figure 47. Frequency Meter LA-6, Tube Socket Voltage and Resistance Diagram, COARSE position

LEFT SIDE

TOP DECK

RIGHT SIDE



NOTES:
1. LINES VOLTAGE 115 OR 230 VOLTS WITH 115/230 VOLT SWITCH IN CORRESPONDING POSITION.
2. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.
3. BAND I 100-225 MCS
   BAND II 225-500 MCS
4. LEVEL CONTROL IN MAXIMUM CLOCKWISE POSITION.

Figure 48. Frequency Meter LA-6, Tube Socket Voltage and Resistance Diagram, FINE position

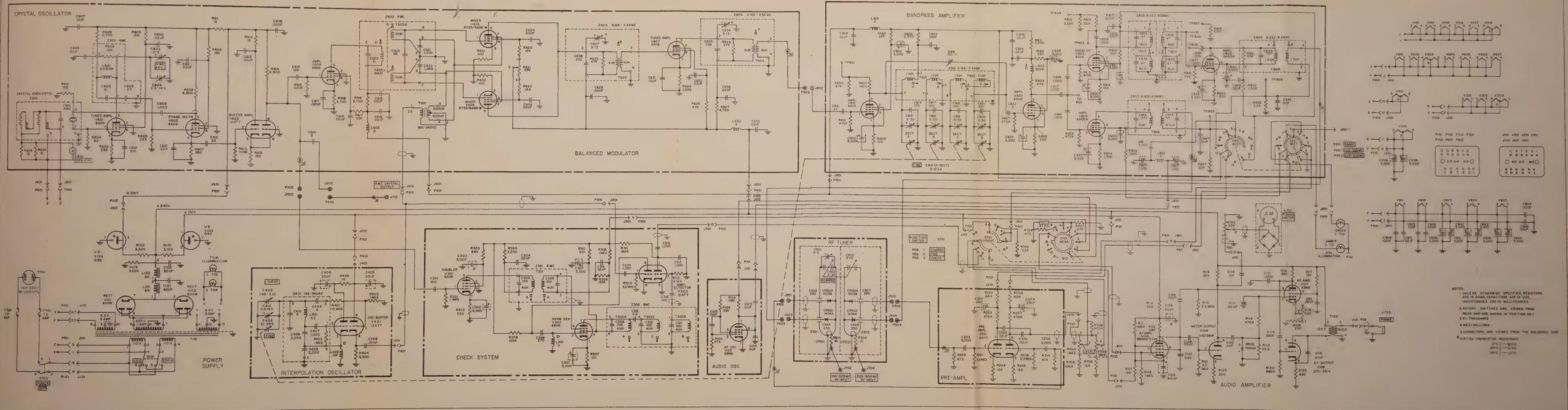


Figure 49. Frequency Meter LA-6, Schematic Diagram

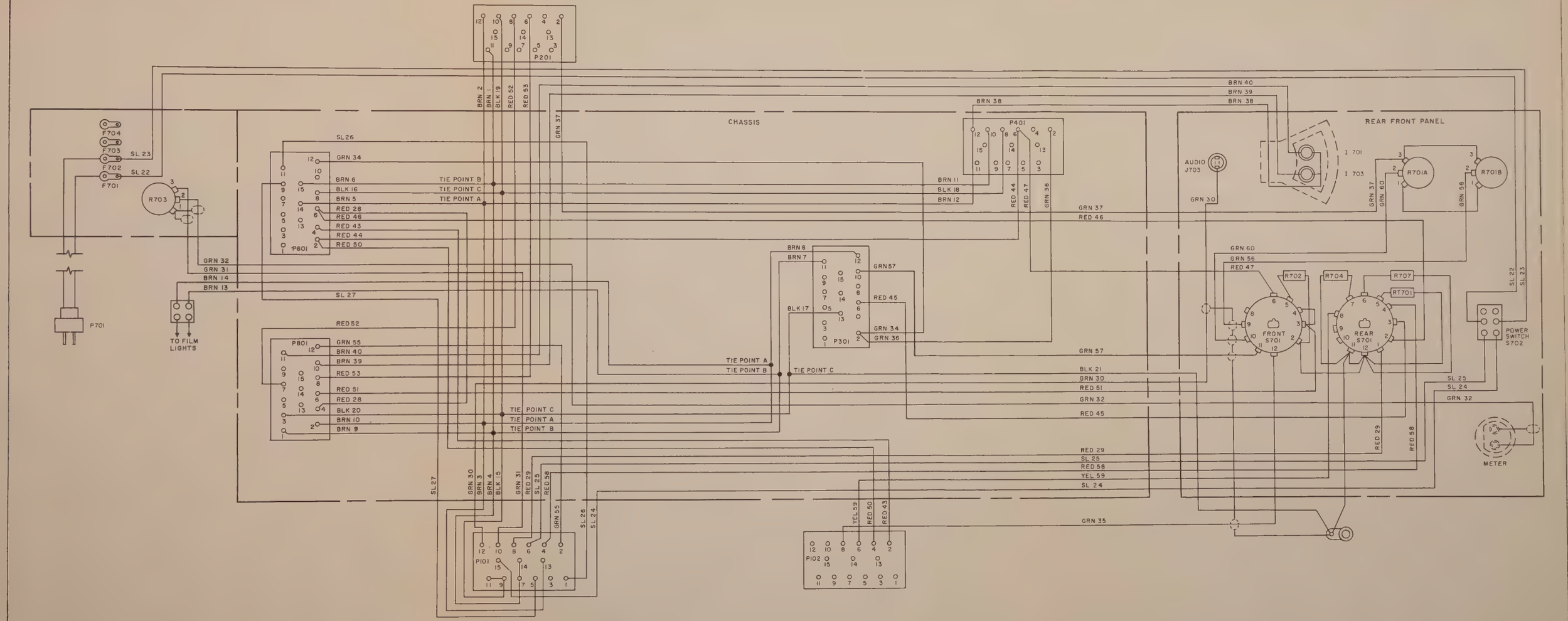


Figure 50. Frequency Meter LA-6, Main Frame Wiring and Interconnection Diagram

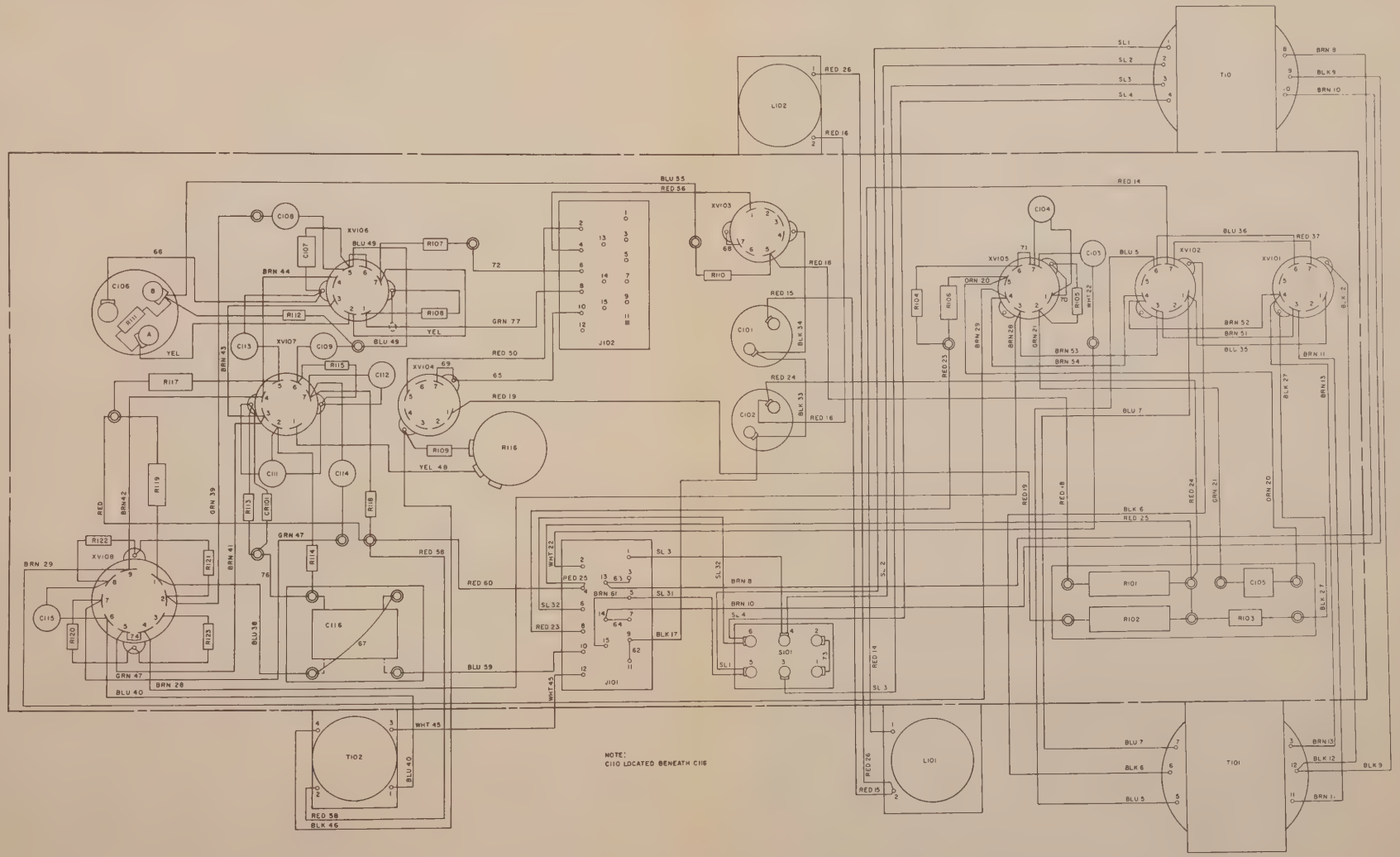


Figure 51. Frequency Meter LA-6, Power Supply Chassis, Wiring Diagram

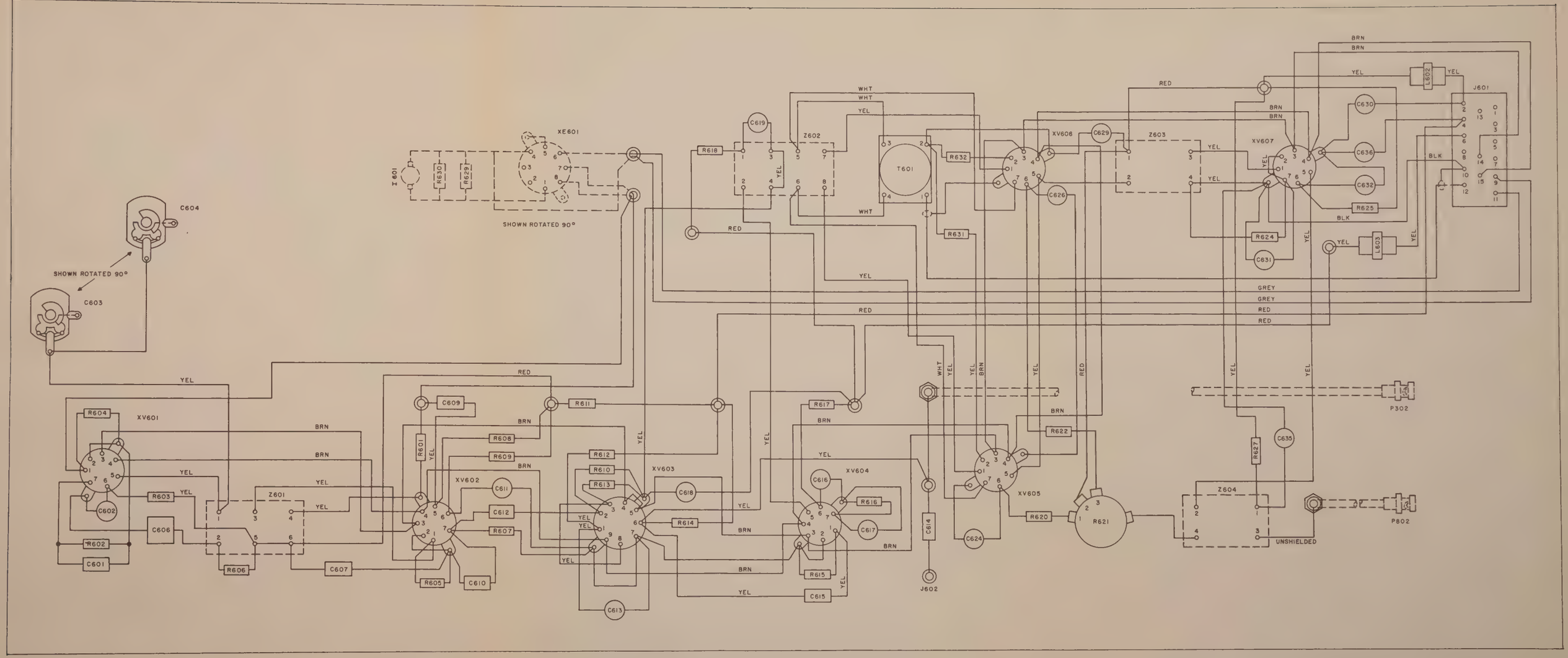


Figure 52. Frequency Meter LA-6, Crystal Oscillator Balanced-Modulator Chassis, Wiring Diagram

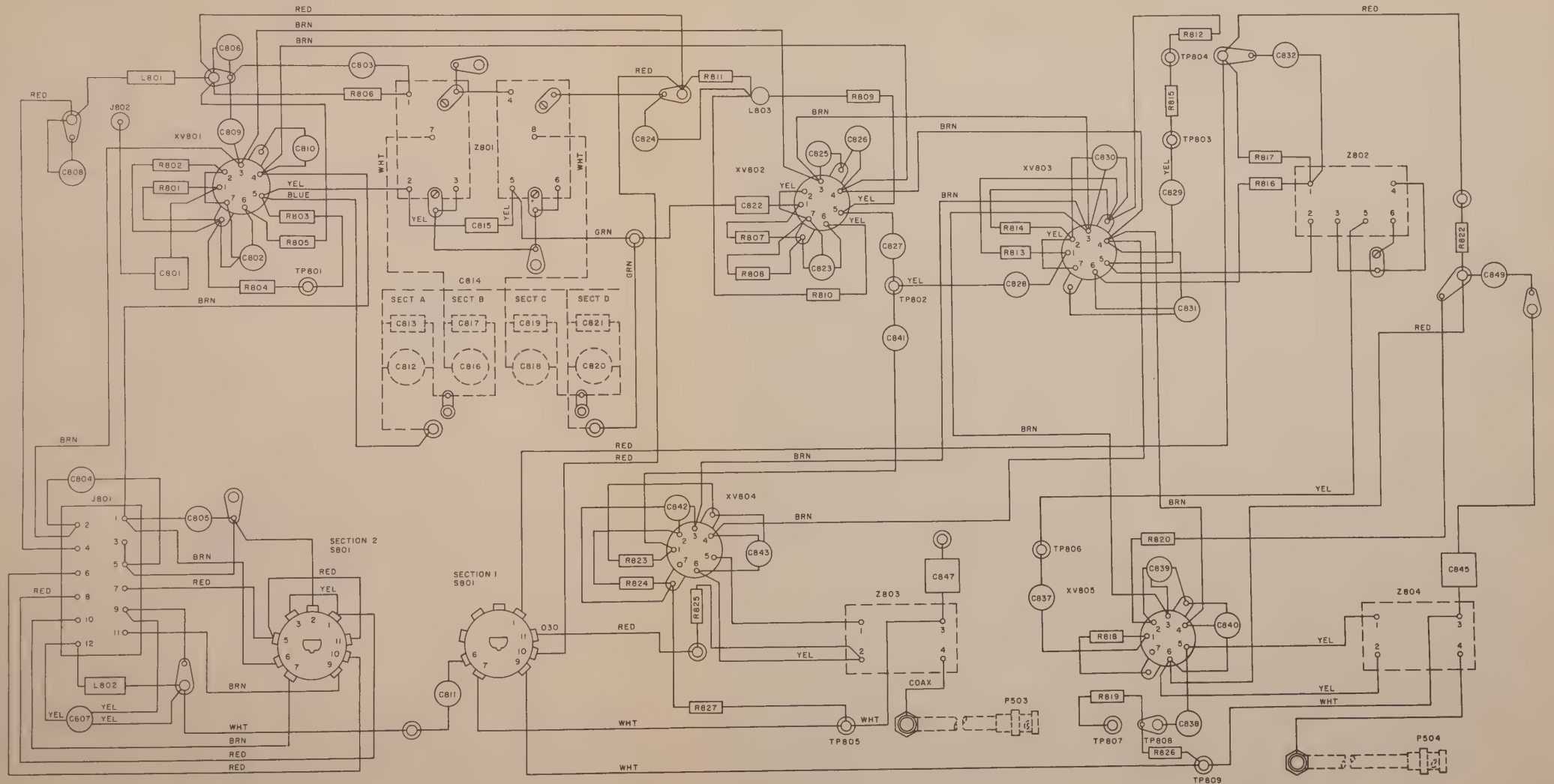


Figure 53. Frequency Meter LA-6, Band-pass Amplifier Chassis, Wiring Diagram

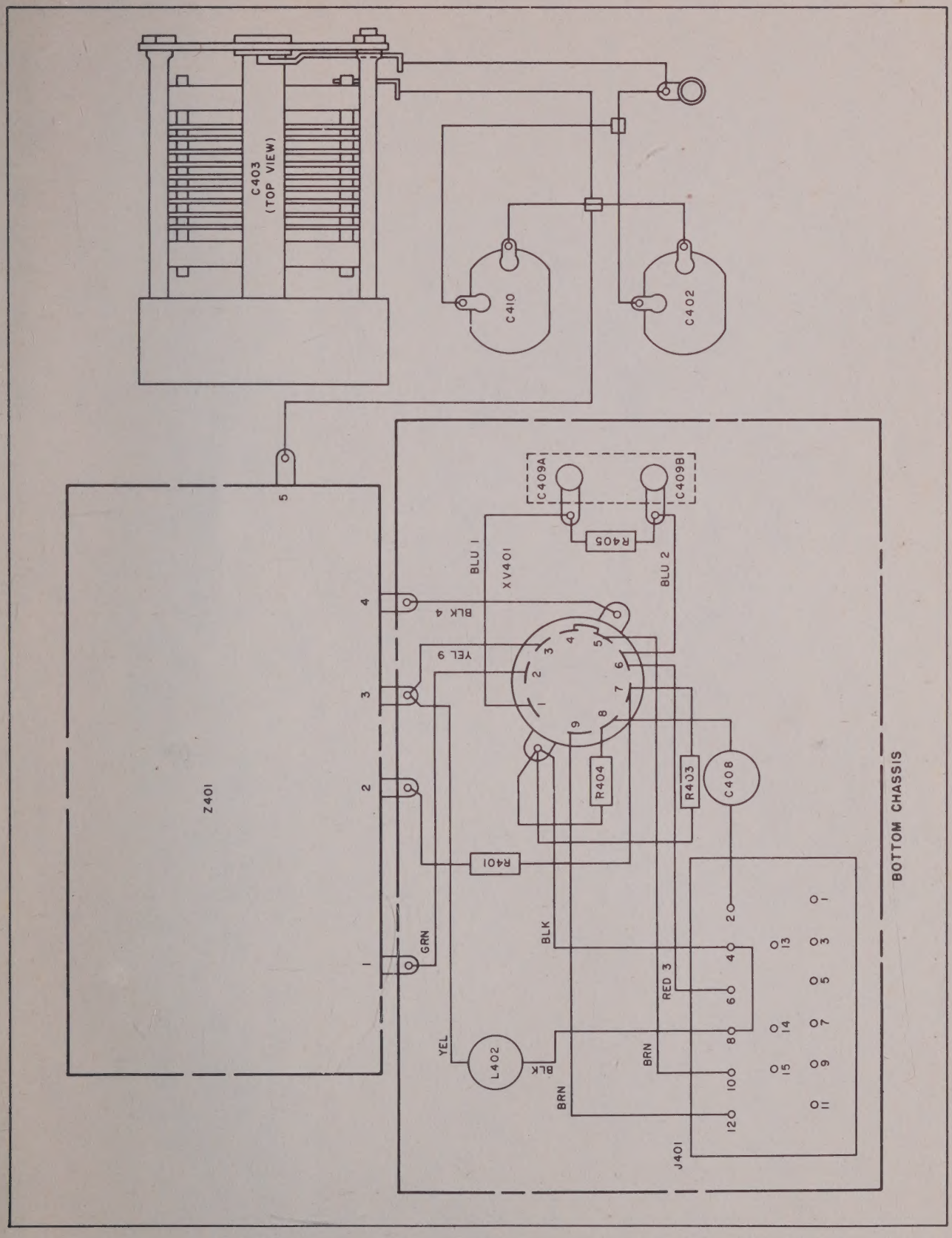


Figure 54. Frequency Meter LA-6, Interpolation Oscillator Chassis, Wiring Diagram

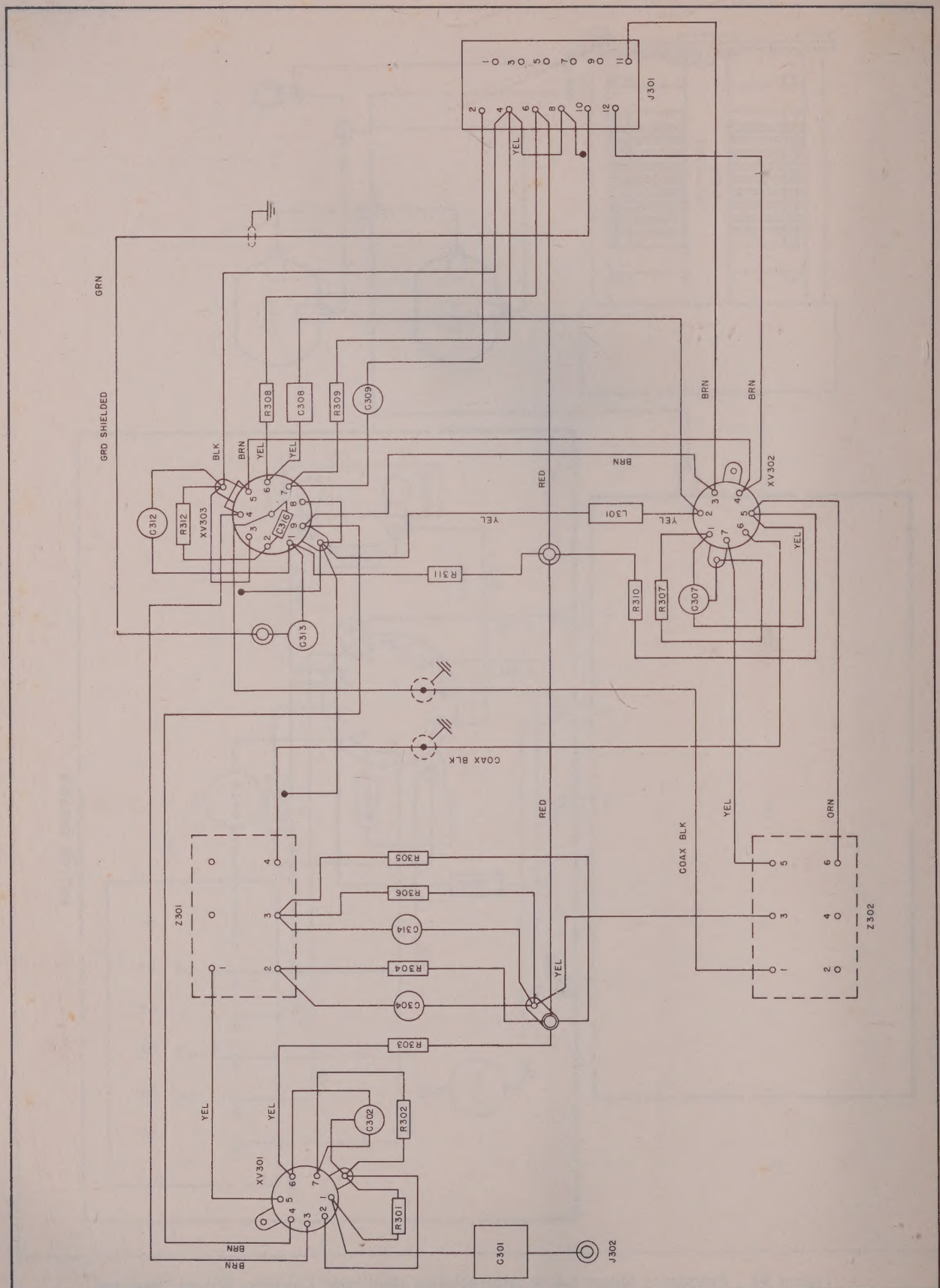


Figure 55. Frequency Meter LA-6, Check System Chassis, Wiring Diagram

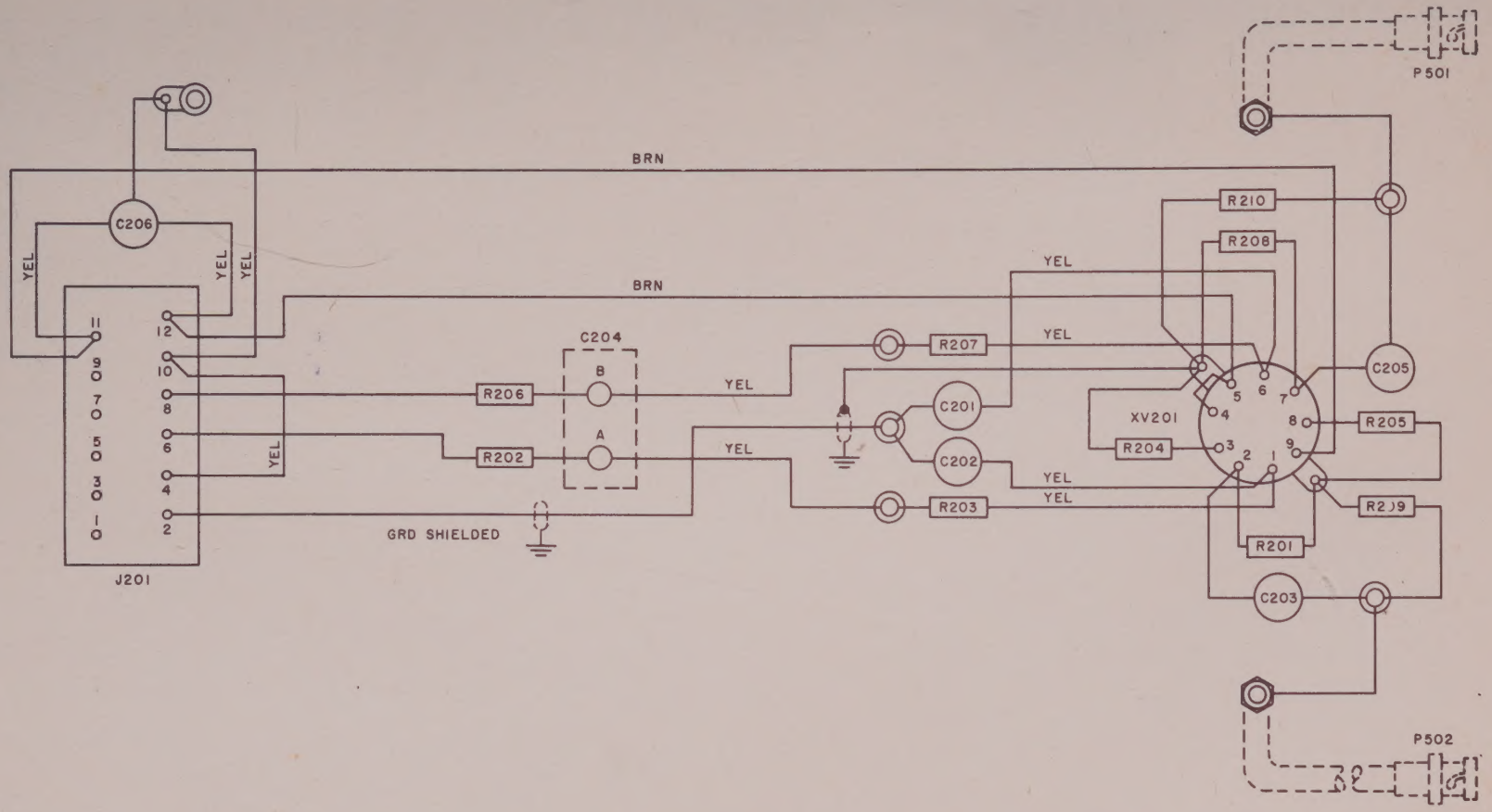
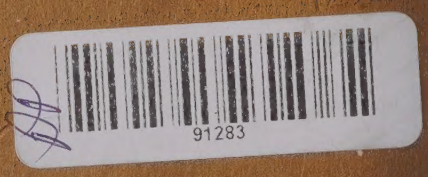


Figure 56. Frequency Meter LA-6, Preamplifier Chassis, Wiring Diagram



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